



Arslantepe, Malatya (Turkey)

Textiles, Tools and Imprints of Fabrics from the 4th to the 2nd Millennium BCE

Frangipane, M.; Andersson Strand, Eva Birgitta; Laurito, R.; Möller-Wiering, S.; Nosch, Marie-Louise Bech; Rast-Eicher, A.; Lassen, Agnete Kjeldal Wisti

Published in:
Paleorient

Publication date:
2009

Document version
Publisher's PDF, also known as Version of record

Citation for published version (APA):
Frangipane, M., Andersson Strand, E. B., Laurito, R., Möller-Wiering, S., Nosch, M-L. B., Rast-Eicher, A., & Lassen, A. K. W. (2009). Arslantepe, Malatya (Turkey): Textiles, Tools and Imprints of Fabrics from the 4th to the 2nd Millennium BCE. *Paleorient*, 35(1), 5-29.

ARSLANTEPE, MALATYA (TURKEY): TEXTILES, TOOLS AND IMPRINTS OF FABRICS FROM THE 4th TO THE 2nd MILLENNIUM BCE

M. FRANGIPANE, E. ANDERSSON STRAND, R. LAURITO, S. MÖLLER-WIERING,
M.-L. NOSCH, A. RAST-EICHER and A. WISTI LASSEN

Abstract: *Textile production is one of the oldest crafts and has played a crucial role in societies. Yet, very few archaeological textiles are preserved and we must therefore rely on the remains of textile tools. In this paper, a group of scholars reviews two millennia of textile tools from Bronze Age Arslantepe. The size and weight of the tools inform about the textile production carried out at the site and illustrate how this production changes over time. Fortunate finds of textile remains at Arslantepe allow for an insight into the fibre and techniques. The remains of an early 3rd millennium goat hair textile of exceptional quality demonstrate the advanced state of the craft and the functionality of the textile tools.*

Résumé: *La production de textiles, l'une des plus anciennes activités artisanales, a joué un rôle majeur dans les sociétés. Pourtant, très peu de textiles archéologiques ayant été préservés, il faut travailler sur les restes d'outils liés à la production textile. Les auteurs de cet article analysent les outils datés de l'âge du Bronze couvrant ainsi une période de deux millénaires à Arslantepe. La taille et le poids des outils renseignent sur la production textile du site et montrent comment cette production a évolué au fil du temps. Les trouvailles exceptionnelles de fragments de tissu permettent d'envisager les fibres et les techniques utilisées. Les restes archéologiques d'un tissu en poils de chèvre, d'une qualité exceptionnelle et datant du début du III^e millénaire, témoignent d'une haute technicité de l'artisanat textile et de la fonction des outils.*

Keywords: *Bronze Age; Textiles; Tools; Production; Weaving.*

Mots-clés: *Âge du Bronze; Textiles; Outils; Production; Tissage.*

The mound of Arslantepe is situated in the Malatya plain in present-day Turkey, north of the Taurus Mountains, and not far from the right bank of the Euphrates River.

The long and continuous habitation sequence of the Arslantepe mound—from the Late Chalcolithic (4th millennium BCE) to the Bronze Age and until the Byzantine period—and the very large excavated area provide an excellent opportunity for investigating the nature and development of the important activity of textile production. Arslantepe represents a key site in Eastern Anatolia and includes functionally well-defined archaeological contexts of both a domestic and a public nature.

The long habitation sequence of Arslantepe is also characterised by a number of radical and sometimes even abrupt shifts in the culture and organisational structure of the society: a process of economic centralisation and strong links with the Mesopotamian world in the 4th millennium (periods VII and VI A) was followed by a phase of crisis and radical change in the political and economic system, as well as conflicts and instability during the first centuries of the 3rd millennium (periods VI B to VI C), during which new external relations were established with the Eastern and North-Eastern Anatolian cultural environments. This period was characterised by dialectical relationships alternating between

Table 1 – Chronological distribution of the recorded objects with contexts and date.

			Loom weights	Spools	Spindle whorls	Other textile tools	Total
VII	Settlement	Household	23	1	19	1	44
		Pit			5	2	7
		Other			14		14
		Workshop			2		2
VI A	Settlement	Household	19		3	1	23
		Pit	1			3	4
		Other				2	2
	Palace	Household			1		1
		Other	1	1	4	1	7
VI B1	Settlement	Household			1		1
		Pit	1				1
		Other			1	1	2
VI B2	Settlement	Household	1		8	1	10
		Pit			3		3
		Other			1		1
VI C	Settlement	Household			1		1
		Pit	1		2	3	6
		Other			1		1
VI D	Settlement	Household		4	2	2	8
		Pit			1	1	2
		Other	1		3	1	5
V A	Settlement	Household	57			3	60
		Pit	4		1	6	11
		Other	5	2	1	4	12
Total			114	8	74	32	228

prevailingly sedentary and mobile ways of life. Finally, in the second half of the 3rd millennium and early 2nd millennium, Arslantepe underwent a new process of sedentarisation and cultural regionalisation with the development of new territorial patterns and new forms of craft-specialisation (periods VI D and V A). Together, these changes, which are nowadays relatively clear in their dynamics, offer an excellent basis for the understanding of the developments in textile production in Eastern Anatolia in different socio-political contexts.

In the present study, we focus on textile production at Arslantepe through the analyses of textile tools, study of contexts, and technical analyses of textile remains deriving

from the widely investigated levels from the Late Chalcolithic to the Middle Bronze Age. From this long sequence, more than 300 textile tools were recorded at Arslantepe, of which 228 items can be assigned to specific contexts and periods (table 1).¹ This number of textile tools is of course not statistically representative of the whole production from the middle of the 4th to the first quarter of the 2nd millennium BCE. However, in combination with a meticulous archaeological documentation that allows precise re-contextualisation of the finds, the analysis of these tools is a key to the understanding of textile production and technology.

In the following, Late Chalcolithic-Bronze Age textile technology and its developments at Arslantepe through time are examined, and textile tools for spinning and weaving are systematically reviewed and analysed, also taking into consideration their archaeological contexts. The results based on textile tools are combined with hitherto unpublished evidence for actual archaeological textiles found at Arslantepe. This rare co-occurrence of textile tools and textile remains enables a new perspective and makes it possible to start building up a picture of the Bronze Age textile production.

ARSLANTEPE: SPINNING TOOLS AND TECHNIQUES

Eighty-eight spindle whorls have been unearthed from Arslantepe, of which 74 came from stratified layers (table 1). The majority of the whorls are made of bone, but also spindle whorls made of clay, stone and metal have been found at the site. The bone spindle whorls differ markedly from the stone and clay spindle whorls in that they form a more homogeneous group regarding weight² and diameter (fig. 1): the bone whorls' diameter is much greater in relation to their weight, compared to the stone or clay whorls. A functional explanation may be that whorls with a large diameter are well suited for spinning a hard-spun thread, in particular from vegetal fibres, and therefore the spinners chose whorls made of *bos femur* heads, which naturally have a large diameter.

The basic shapes of spindle whorls are spherical, convex, discoid, conical and biconical. However, bone spindle whorls are generally convex or conical in shape, due to their physical

1. The more than 50 pierced, rounded sherds are excluded from this analysis.
2. It is, however, quite difficult to calculate how much weight the bone whorls have lost over time due to the bone material drying out.

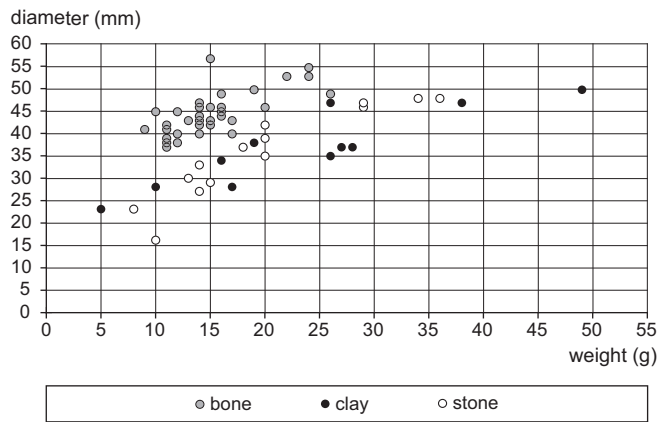


Fig. 1 – The relationship between spindle whorl material and weight/diameter (N = 64).

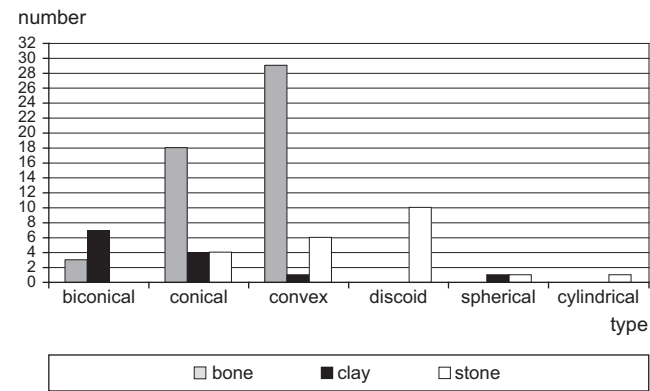


Fig. 2 – The relationship between spindle whorl type and material (N = 85). Please note that only spindle whorls made of clay, stone and bone are included.

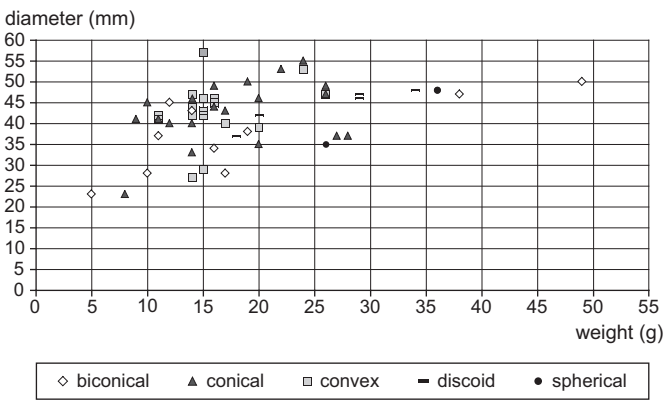


Fig. 3 – The relationship between spindle whorl type and weight/diameter (N = 56).



Fig. 4 – Variations from thin to thick ‘threads’. The first line (left) corresponds to a thread spun with a 4 g spindle whorl (0.3 mm), while the 9th line corresponds to a thread spun with a 44 g spindle whorl (0.9 mm). (© The Danish National Research Foundation’s Centre for Textile Research)

characteristics. The clay spindle whorls are mostly biconical or conical, while the stone spindle whorls frequently have a discoid or convex shape. Thus, the shape is clearly related to the material (fig. 2), whereas there is no relation between the shape of the spindle whorls and their weight/diameter (fig. 3).

As can be seen in figure 3, conical, biconical, convex, discoid and spherical shapes are associated with a large variety of weights and diameters. Since weight and diameter are the two functional parameters defining the thread quality, this suggests that spindle whorl shapes (biconical, convex, discoid and spherical) are the result of non-functional parameters such as tradition, taste, or convenience of manufacture.

Spinning experiments have confirmed that it is primarily the fibre quality, the weight and the diameter of the whorl that affect the spun yarn. If one spins a thin thread, with few fibres per cm, with a heavy spindle whorl, the thread will break because of the weight of the spindle whorl; if one spins a thick thread, with many fibres, on a light spindle whorl, the spindle will only rotate with difficulty, and the yarn will not be strong enough to be used in a weave. For an experienced spinner, it is more convenient to produce a thin thread with a light spindle, and thicker thread with a heavier spindle.³

A yarn can be described as “thin” or “thick”, and “hard spun” or “loosely spun”. Spinning tests have demonstrated that the relationship between a spindle whorl’s weight and diameter can affect the twist angle. A light spindle whorl with a large diameter will yield a more twisted and harder spun thread than spinning on a whorl with a smaller diameter (fig. 4).

Different yarn thicknesses require different weight tension when the yarn is used as a warp in a warp-weighted loom. If the tension on the warp threads is too low, it can be difficult to change the shed; if the tension is too high, the warp threads will break. According to spinning tests, a thread spun with a very light spindle whorl requires a tension of approximately

3. ANDERSSON *et al.*, 2008.

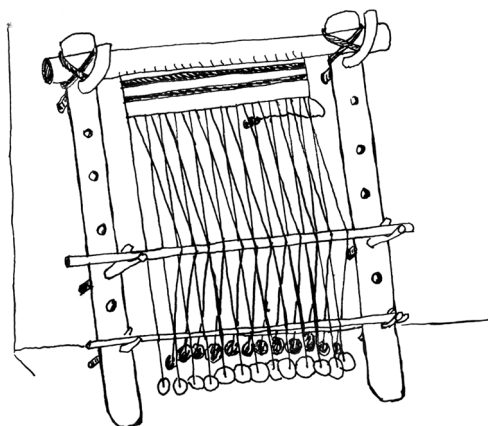


Fig. 5 – Warp weighted loom.

10 g per warp thread, while a thread spun with a much heavier spindle whorl requires 40 g tension, or more. The thicker the thread is, the more warp tension is needed.

An overview of the spindle whorls from Arslantepe indicates that the spinners could have spun many different types of threads, thin and thick, hard spun and more loosely spun (fig. 3).

ARSLANTEPE: WEAVING TOOLS AND TECHNIQUES

The warp-weighted loom was used in Bronze Age Arslantepe (fig. 5). A total of 117 loom weights are recorded, of which 114 came from stratified layers (table 1). The loom weights were made of fired clay, unfired clay or stone (only 3 are of the latter). The majority of the weights made of unfired clay have a hemispherical shape, whereas the loom weights made of fired clay in general have a conical or discoid elliptical shape (table 2).

Weight and thickness are the two functional parameters that determine the possible types of fabric that could be woven with the loom weights on a warp-weighted loom.⁴ Weaving tests with different types of loom weights have confirmed that if the weaver wants to produce an open fabric with thick yarn, (s)he should choose heavy, thick loom weights; if (s)he wants to weave a coarse, dense fabric, (s)he should choose heavy but thin loom weights. On the other hand, if (s)he wants to produce

Table 2 – Arslantepe, loom weights and spools, number of items of different types and materials (where these can be identified).

	fired clay	unfired clay
conical	17	
discoid elliptical	31	11
flat rectangular	2	2
flat trapezoidal	2	
hemispherical	1	19
other		
spherical ovoid	3	
spherical rounded		
spool	7	1
Total	63	33

an open fabric with thin threads, (s)he should choose light, thick loom weights. Finally, if (s)he wants to weave a dense fabric with thin yarn and many threads per cm², (s)he should choose light, thin loom weights. An overview of loom weights from Arslantepe indicates a varied production of fabrics produced with both thin and thicker threads (fig. 6).

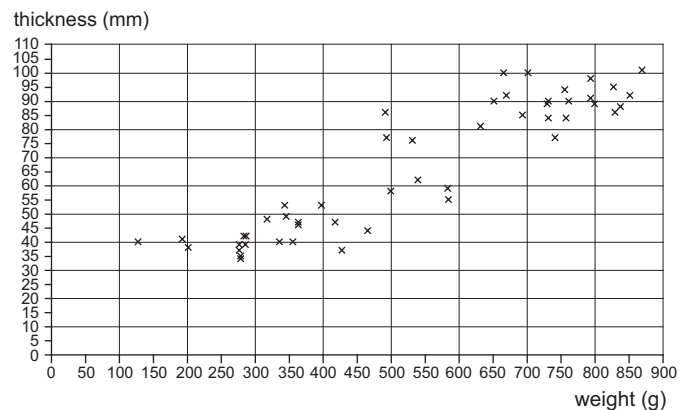


Fig. 6 – The relationship between loom weight and thickness ($N = 49$).

Given the weight and thickness of loom weights, combined with the results of experimental spinning and weaving, it is possible to determine the likely products of the loom weights. For each loom weight, various setups, each representing a type of warp thread with a specific warp tension requirement, are used for these calculations. The suitability of the loom weight for each setup is then assessed.

Loom weight ARS-165 (table 3) is used below as an example in a tabby weave:

4. MÅRTENSSON *et al.*, 2009.

Table 3 – Calculation of various loom setups with loom weight ARS-165 (weight 492 g, thickness 8.6 cm).

Warp threads requiring ¹	10 g warp tension	20 g warp tension	30 g warp tension	40 g warp tension
Number of warp threads/loom weight ²	49	25	16	12
Number of warp threads per 2 loom weights ³	98	50	32	24
Warp threads/cm ⁴	11	6	4	3
Technical evaluation of the tool's suitability	Too many warp threads/loom weight	Best suitability	Possible, but few warp threads/cm	Few warp threads/cm

1. The (vertical) warp threads in a loom setup of the warp-weighted loom need a certain tension in order to hold the threads in place while weaving. The warp tension depends on the warp threads' fineness, on how hard they are spun, on the fibre quality, and on the degree of fibre preparation.
2. The weight of the loom weight measured in grams divided by the warp tension measured in grams.
3. One loom weight in the front layer, and one in the back layer. Every second warp thread is in the front layer and every second warp thread is in the back layer.
4. The number of warp threads per set of two loom weights (one in the front layer and another in the back layer), divided by the thickness of the loom weight measured in cm.

The time for spinning and the yarn consumption in a fabric made with this tool can be calculated based on a balanced tabby of 100 x 200 cm. For ARS-165, the loom setup with a 20 g warp tension would yield the following result:

- Starting border (width of the fabric): 100 cm;
- Number of loom weights needed: 24;⁵
- Number of warp threads: 600 threads;⁶
- Amount of warp yarn = 1,200 m;⁷
- Weft in a balanced tabby: 1,200 m;
- Total amount of yarn (+ 2%): 2,448 m.⁸

The time needed for spinning this amount of thread is 49 hours if spun on a spindle with a whorl weighing 18 g plus the sorting and preparing of the fibres, and time for preparing the set up, weaving and finishing.⁹

In addition to the loom weights and spindle whorls, a smaller number of other textile tools has also been recovered from Arslantepe. Besides needles, there are objects that can be interpreted as pin beaters, brushes for fibre preparation and shuttles. These tools, however, will not be considered in the present study.

5. The width of the starting border divided by the thickness of the loom weight, and multiplied by the number of sheds, in this case two.
6. With 6 warp threads per cm, there will be 600 warp threads in this fabric of a width of 100 cm.
7. The number of warp threads multiplied by the length in m.
8. A fabric is the result of two thread systems crossing at right angles. Even if both the warp and the weft threads are taut, the threads will never be fully stretched when they cross over and under each other. Furthermore, in the last part of the warp there will always be some wasted warp yarn. Therefore 2% of the total yarn is added in the calculations.
9. ANDERSSON *et al.*, 2008.

TEXTILE PRODUCTION IN ARSLANTEPE PERIOD VII (3800-3350 BCE)

During the first half of the 4th millennium, corresponding to period VII in the Arslantepe internal sequence¹⁰ and to the phases of Late Chalcolithic 3-4 in the regional chronology,¹¹ the occupation at the site was at its maximum extent of about 3.5-4 ha., *i.e.*, occupying the whole mound.

In the south-western part of the mound, imposing public and private buildings have been discovered. In particular, a monumental building with thick walls, wall paintings and white plastered mud-brick columns has been unearthed. Judging from the architectural features and the materials found inside, this structure appears to be an elite residential building.¹² A number of different tools that may be connected to textile activities, such as numerous bone spindle whorls, awls and pointed tools, have been found, in particular in rooms A582 and A617 (fig. 7). However, no loom weights have been found in these elite buildings.

The south-western section of the mound also revealed a huge ceremonial building (Temple C) in which activities connected with food redistribution and administrative control over goods were probably performed in a ritualised or ceremonial way,¹³ as hundreds of mass produced bowls and numerous *cretulae*¹⁴ testify. No remains of textile tools were unearthed in this building either.

10. FRANGIPANE, 2000 and 2004.
11. ROTHMAN, 2001.
12. FRANGIPANE, 1993.
13. *Ibid.*, 2000.
14. *Cretula* is the term currently proposed by E. Fiandra and M. Frangipane to name what has variously been called a “clay-sealing” or “bulla” by different authors. The term refers to any lump of malleable material (clay

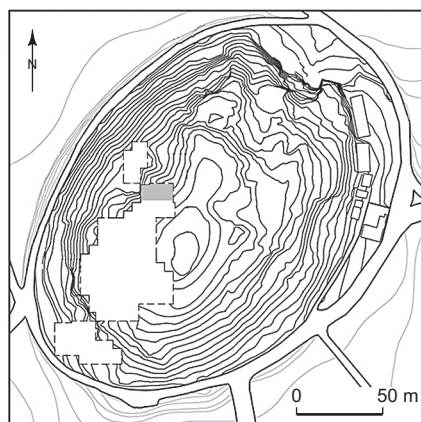
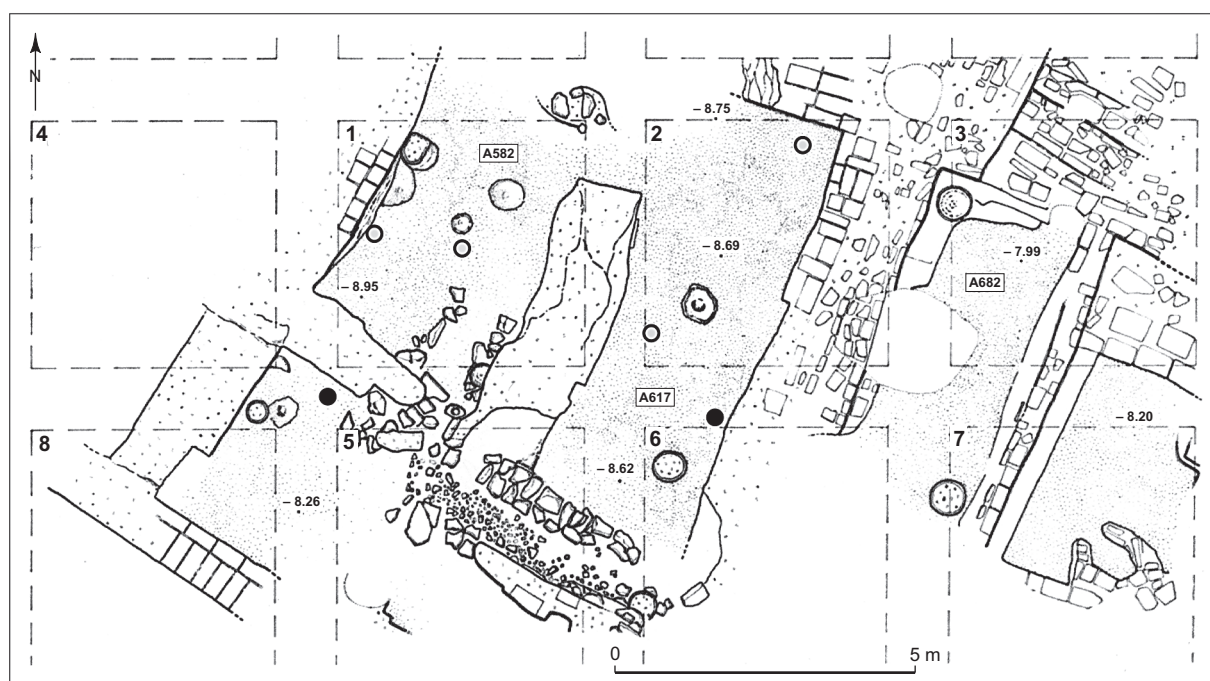


Fig. 7 – Arslantepe (period VII). Plan of the private monumental building with spindle whorls distribution. ● bone spindle whorls from the filling layers; ● bone spindle whorls found in situ. (© Archive of the Italian Archaeological Mission in Eastern Anatolia – Sapienza University of Rome)



Finally, in the north-eastern border of the mound, excavations have brought to light private dwellings consisting of small buildings with one or two rooms with external working areas, which constitute a peripheral sector of the general habitation area.¹⁵ Here various kinds of domestic tools have been found connected with these domestic units; among them, some spindle whorls are the only clear evidence for textile-related activities (fig. 8:a-q). Spindle whorls are the most numerous

(40 items, nearly 50% of the total of 88 spindle whorls recorded at Arslantepe), and the most significant find related to textile production activities in period VII. They come mainly from residential buildings or working areas, both in the south-western/western zone and in the north-eastern area. Very few spindle whorls derive from pits and filling layers. The majority (28 items) are made of bone obtained from *bos femur* heads and thus convex or conical in shape. They form a rather homogeneous group of whorls, varying between 11-26 g and 28-57 mm in diameter.¹⁶ Therefore, the spinners in early 4th millennium

in the majority of ancient sites) used to seal objects and containers and usually bearing the impression of a seal on its upper surface. FRANGIPANE, 2007: 16.

15. PALMIERI, 1978.

16. The spindle whorls made of stone and clay are heavier, 27-38 g, and they measure 37-48 mm in diameter.

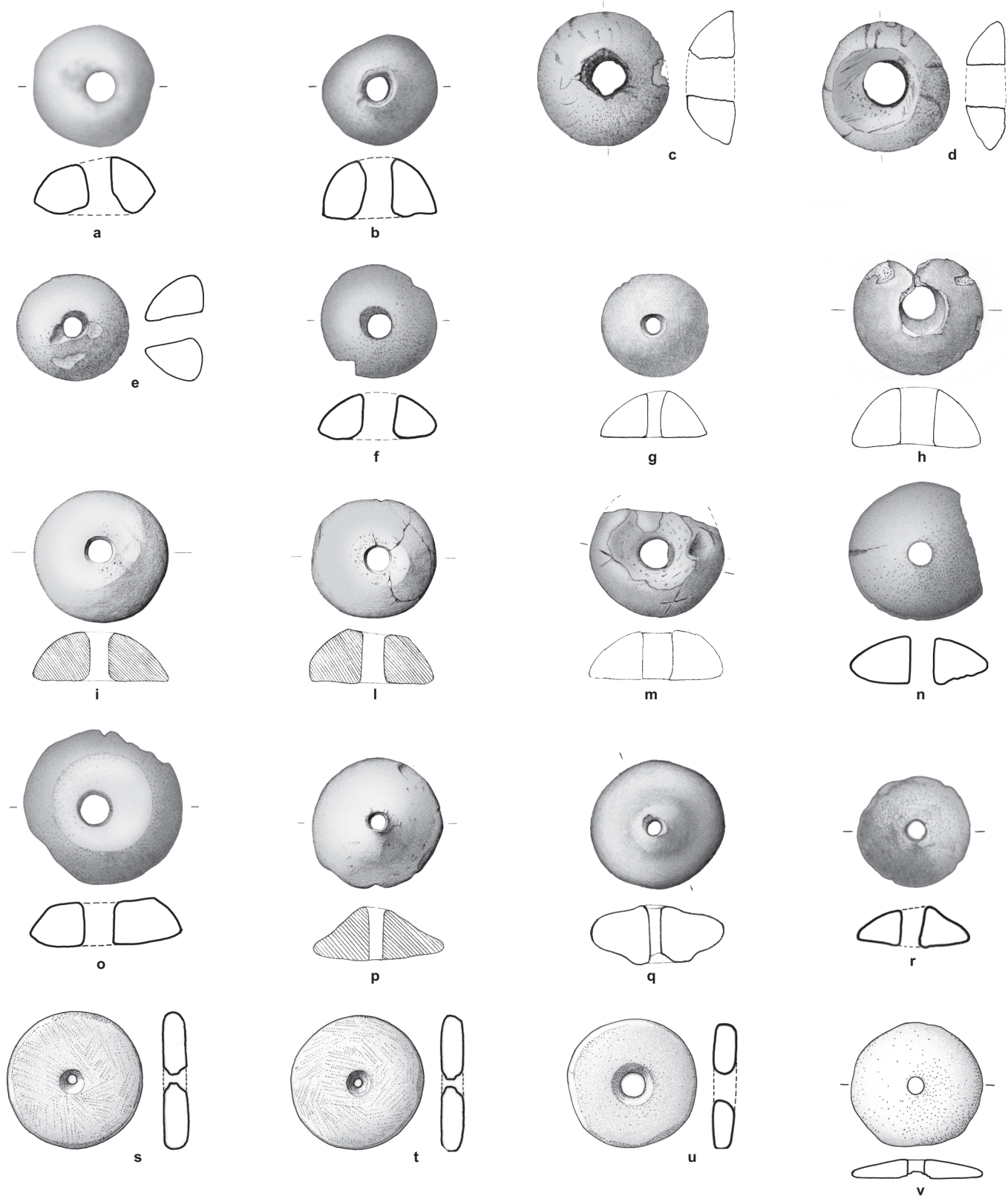


Fig. 8 – Arslantepe. *a-o*: bone spindle whorls from Arslantepe VII; *p-q*: spindle whorls in clay from Arslantepe VII; *r*: spindle whorl in clay from Arslantepe VI A; *s-u*: spindle whorls in stone from Arslantepe VII; *v*: spindle whorl in stone from Arslantepe VI A. Scale 1:2. (Drawing treatment: T. D'ESTE; © Archive of the Italian Archaeological Mission in Eastern Anatolia – Sapienza University of Rome)

Arslantepe were able to spin both thin and thick yarns with the available spinning tools.

An assemblage of 23 loom weights was found *in situ*, together with various pots and grinders, in a room, A923, a household context located in a terraced area along the western flank of the mound, to the west of the elite building with columns and probably earlier than it. The loom weights are hemispherical in shape (fig. 9:a-d).¹⁷ Their weight varies from 492-870 g and their thickness from 77-101 mm.¹⁸

The possible loom setups for these looms weights can be calculated, and this provides information about the fabrics that may have been produced with these tools. Loom setups are calculated for three different looms weights from the assemblage: the lightest (ARS-165) (see above, table 3), the heaviest (ARS-159) (table 4) and, finally, a loom weight representing the average of the set (ARS-163) (table 5). For each loom weight, four tabby setups, each representing a type of warp thread with a specific warp tension requirement, are used for the calculations. The suitability of the tool for each setup is then assessed.

The calculations demonstrate that a fabric produced with these three different loom weights would have had *ca* 6 threads/cm in the warp. If it were a balanced fabric, it would have had 6 warp threads and 6 weft threads/cm², and if the fabric were weft-faced, it would have had more weft threads than warp threads/cm. The three loom weights would function together in a loom setup with warp threads of 30 g warp tension. Nevertheless, optimal weaving is obtained if the weaver chooses to work with either the lighter and thinner loom weights or the heavier and thicker loom weights. It therefore alternatively can be suggested that these loom weights belong to two different loom setups.

Loom weight ARS-163 represents the average weight of the group. The time for spinning and the yarn consumption in a fabric made with this tool can be calculated. The calculations are based on the weaving of a balanced fabric of 100 x 200 cm. For this tool, the loom setup with a 20-30 g warp tension would yield the following result: Number of loom weights needed is 20; *ca* 500 warp threads of 2 m each = 1,000 m; 1,000 m weft threads; total amount of yarn (+ 2%) = 2,040 m. The time needed for spinning this amount of thread is 41 hours if spun on a spindle with a whorl weighing 18 g.¹⁹

17. Eighteen of them have a hemispherical shape, but it was not possible to determine the shape of the last five weights.

18. The information on weight and thickness is based on data from 12 completely preserved loom weights in the assemblage.

19. ANDERSSON *et al.*, 2008.

Finally, it is worth mentioning that these 23 loom weights are made of unfired clay. Such textile tools are a rich source of information. However, this information only becomes available by careful excavations, vigilant archaeologists and adequate measures for conservation during the excavation and also during storage.

The fibres for textile production in the Chalcolithic and Early Bronze Age were probably mainly vegetal fibres such as hemp, nettle or flax.²⁰ Stems and fibres from flax (*Linus usitatissimum*) were probably used in the Near East since at least the 6th millennium and examples of this plant dated to 5000-4500 BCE were uncovered in Eastern Anatolia at Gerikihaciyan.²¹

TEXTILE PRODUCTION IN ARSLANTEPE PERIOD VI A (3350-3000 BCE)

The following period VI A (3350-3000 BCE)—Late Chalcolithic 5—at the settlement of Arslantepe is characterised by an important proto-palatial complex. Monumental public buildings were built along the south-western slope of the mound, south and east of the Temple C of period VII. They were functionally and architecturally distinguished but form part of a single monumental complex with public functions. Two temples, other ceremonial and representative buildings, a group of storerooms, and areas for internal circulation, *e.g.* passage ways and court yards, were all architecturally connected and were the seat of economic, administrative, ceremonial and religious activities performed in a single, multi-functional architectural assemblage (fig. 10).

Hundreds of wheel-made, mass-produced conical bowls and thousands of *cretulae* found in the palace document a very sophisticated administrative management based on a centralised economic and redistributive system.²²

In this period VI A, an important economic shift took place towards a more specialised animal husbandry,²³ and by the end of the 4th millennium, the raising of sheep and goats was the primary form of livestock economy. This phenomenon was probably related to a more centralised management of

20. The textiles found at Çatal Hüyük were identified as woollen (RYDER, 1965), but serious doubts were subsequently raised (VOGELSANG-EASTWOOD, 1987). See discussion in BRENIQUET, 2008: 84-85.

21. VAN ZEIST, 1979-1980.

22. FRANGIPANE and PALMIERI, 1983; FRANGIPANE, 1993, 1997 and 2007.

23. BÖKÖNYI, 1983.

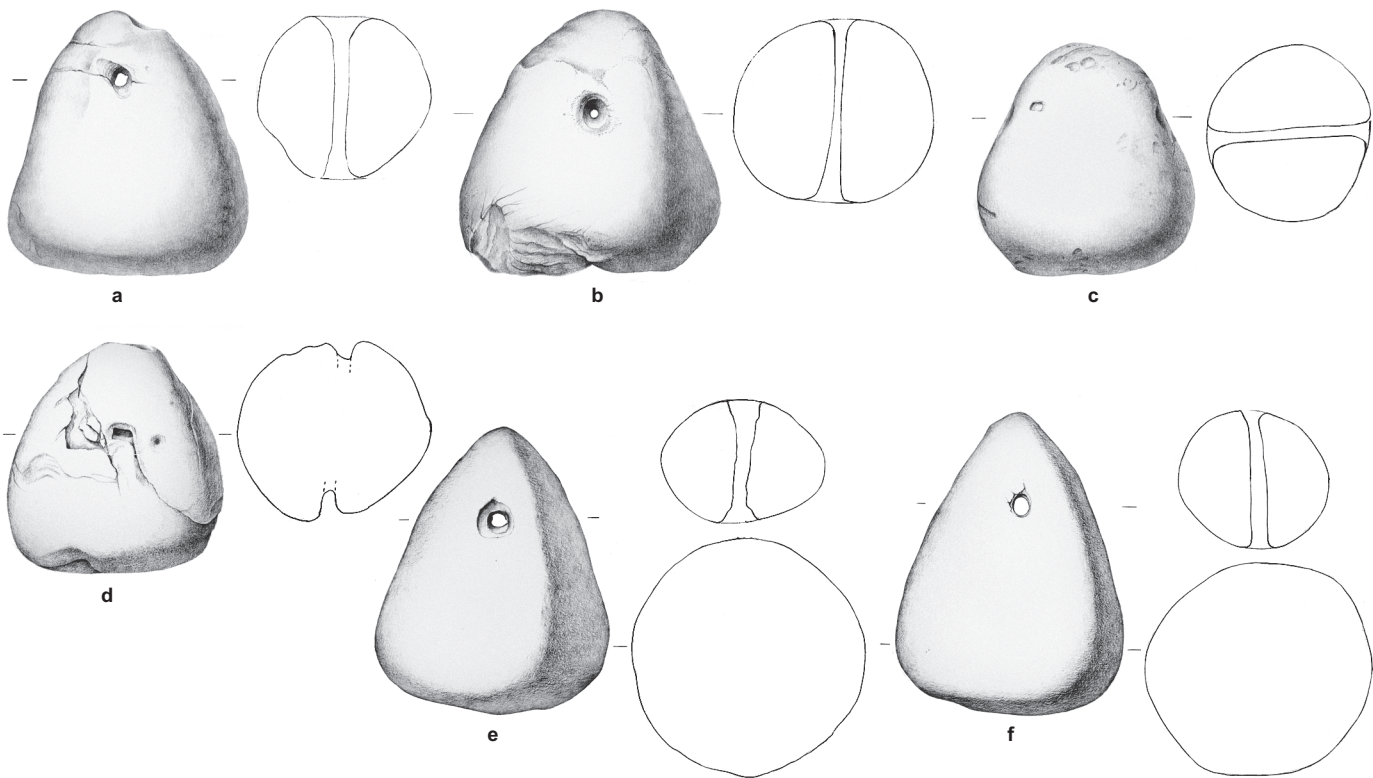


Fig. 9 – Arslantepe. **a-d**: Hemispherical loom weights from A923 (period VII); **e-f**: conical loom weights from A933 (period VI A). Scale 1:3. (Drawing treatment: T. D'ESTE; © Archive of the Italian Archaeological Mission in Eastern Anatolia – Sapienza University of Rome)

Table 4 – Calculation of various loom setups with loom weight ARS-159 (weight 870 g, thickness 10.1 cm).

Warp threads requiring	10 g warp tension	20 g warp tension	30 g warp tension	40 g warp tension
Number of warp threads/loom weight	87	44	29	22
Warp threads/cm	17	8	6	4-5
Technical evaluation of the tool's suitability	Too many warp threads/loom weight	Too many warp threads/loom weight	Best suitability	Possible

Table 5 – Calculation of various loom setups with loom weight ARS-163 (weight 666 g, thickness 10 cm).

Warp threads requiring	10 g warp tension	20 g warp tension	30 g warp tension	40 g warp tension
Numbers of warp threads/loom weight	67	33	22	17
Warp threads/cm	13	7	4-5	3-4
Technical evaluation of the tool's suitability	Too many warp threads/loom weight	Possible, but many warp threads/loom weight	The most suitable, although low thread count/cm	Possible but few warp threads/cm

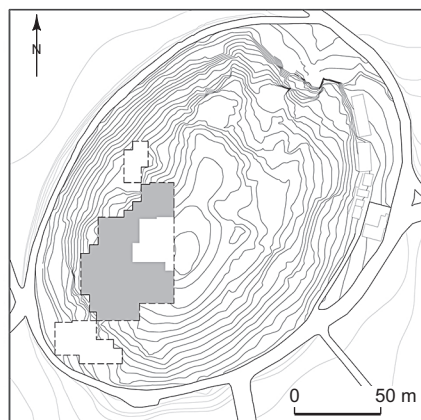
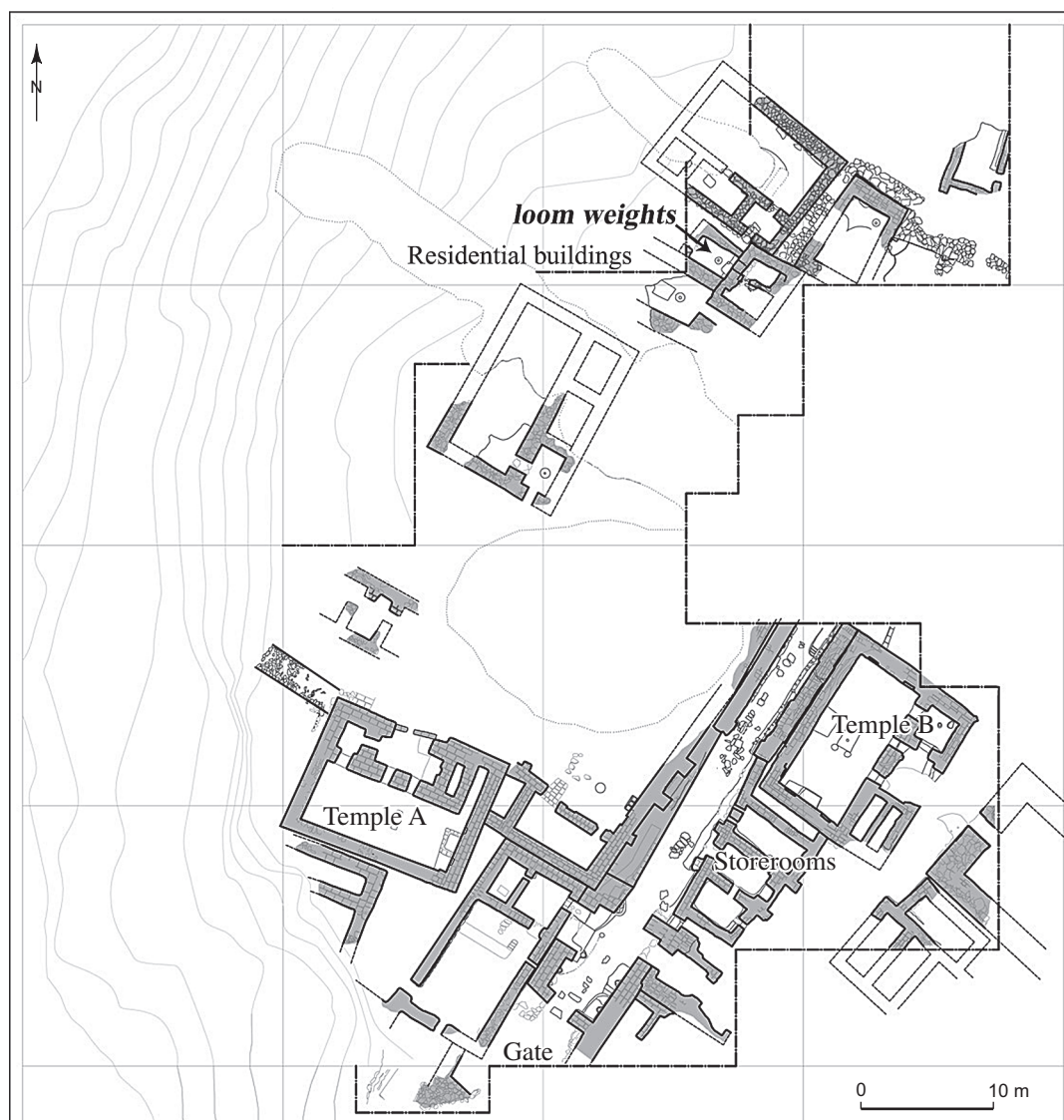


Fig. 10 – Arslantepe (period VI A). General plan of the palace and the residential buildings. (Plan: C. ALVARO; © Archive of the Italian Archaeological Mission in Eastern Anatolia – Sapienza University of Rome)



animal breeding, allowing the easier mobilisation and control of ovicaprines, and may also testify to an increased production of wool to be manufactured into clothing by specialised sectors of textile production.

So far, very few textile tools have been found in the “palace”. However, textile tools such as loom weights, spindle whorls, bone needles and awls come from separate buildings located on an upper terrace to the north and north-west of the palatial complex. The architectural features and the equipment of these buildings suggest that they were residential units; furthermore, their location at a higher elevation on the ancient hill, their proximity to the “palace”, and their imposing architecture seem to suggest that they belonged to individuals of high status.²⁴ In one room (A933), probably used for daily domestic activities, 18 loom weights made of fired clay were found. Seventeen of these have a standardised conical shape (fig. 9:e-f) with weights varying from 624-828 g, and thickness varying from 77-95 mm, with an average of 84 mm.²⁵

The calculations suggest that these loom weights function well with a warp tension of 30 g. The 17 loom weights were found together and were probably used in the same loom setup. With 18 such loom weights, a weaver would have 9 weights in the front layer and 9 weights in the back layer, resulting in a starting border with a width of app. 75 cm (9 weights x 8.4 mm). Twenty-five warp threads would be attached to each loom weight, with every second warp thread being attached to loom weights in the front layer and the remainder being attached to loom weights in the back layer. Thus, every pair of front and back loom weights would have 50 warp threads attached. Since there are 9 such pairs, 450 warp threads would be distributed over the width of app. 75 cm, and thus the spacing would be 6 warp threads/cm. A fabric of 2 m length would require 450 warp threads of 2 m each (= 900 m) and 900 m of weft threads for a balanced tabby, giving a total yarn consumption of 1,836 m. It would take approximately 37 hours to spin the thread needed to produce the fabric in this loom setup if all the yarn was spun on a spindle with a spindle whorl of 18 g.²⁶

Another loom weight (ARS-119) was found on the floor in room A933 and not grouped with the other loom weights. It is quite different from the other loom weights: it has a discoid elliptical shape and is both lighter (585 g) and thinner (55 mm) than the other loom weights. The calculations for this

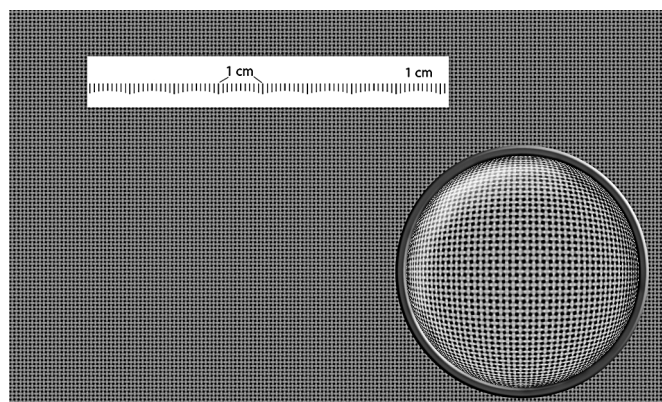


Fig. 11 – A type of fabric that could have been produced with loom weight ARS-119. The suggested fabric, a tabby, has 11 threads per cm in warp and weft. (Drawing: J. BOUTRUP © Designskolen Kolding, Denmark)

loom weight demonstrate that it is suitable for weaving a fabric of 6-11 threads per cm². Thus, this tool seems made for the production of finer fabrics with thinner threads and a higher thread count (fig. 11).

Very few spindle whorls have been discovered from period VI A (fig. 8:r, v), but their weight of 12-30 g would make them adequate spinning tools for producing a thread type suitable for a warp tension of 20-30 g, and suitable for the set of loom weights from room A933.

Confirmation of the calculations above comes from the numerous imprints of cloth on the reverse of more than 160 *cretulae*. The weave can be identified on ca 80 *cretulae*. A plain tabby weave imprint is visible on 68 *cretulae*. Thus far there are imprints of spinning in the s-direction for all examined samples, and the number of threads/cm in each system varies from 8-12. This confirms the thread count and the cloth density calculated above for the ARS-119 loom weight found on the site. Other *cretulae* have imprints from rather coarse textiles, interpreted as sacks by R. Laurito.²⁷ The quality of these coarse fabrics may correspond to the quality calculated for the loom weight set from room A933, with a thread count of app. 6 threads per cm². Again, there seems to be a clear link between the fabric type attested at the site and the calculated capacities of the site's loom weights.

Cloths with different bindings were produced as well, such as knotless netting, and textiles made with sprang technique are also present in the imprint documentation.²⁸ Sprang is a

24. FRANGIPANE, 2002.

25. Weight and thickness were measured on 15 loom weights. Only one of the loom weights (ARS-119) is discoid elliptical in shape and is both lighter (585 g) and thinner (55 mm) than the other loom weights. See below.

26. ANDERSSON *et al.*, 2008.

27. LAURITO, 2007.

28. *Ibid.*: 390-392.

braiding technique suitable for producing flexible textiles.²⁹ This is a useful reminder of the advanced textile technology available in the period.

TEXTILE PRODUCTION IN ARSLANTEPE PERIOD VI B (3000-2750 BCE)

After the sudden and violent fire that completely destroyed the public complex of period VI A, the site lost its function as a central settlement for a while. The following period VI B1 (3000-2900 BCE) is characterised by multiple and seasonal occupations of light wooden huts and fences built immediately on top of the destroyed palace. It seems very likely that the settlers were groups of shepherds with stable relationships to Eastern Anatolian and Transcaucasian communities. In period VI B1, textile tools are rarely found.

Immediately after this relatively short period of temporary and probably seasonal occupation by transhumant groups, a rural village with small mud-brick houses was built (period VI B2, 2900-2750 BCE). Our conception of phase VI B2 has become more complex with the discovery of a massive mud-brick wall built on the top of the mound that must have protected a central and higher part of the settlement—a sort of fortified citadel—which was surrounded by the village.³⁰ This suggests the reestablishment of political power, though very different from the previous centralised redistributive system attested in period VI A. This is further supported by the discovery of a very rich burial of a high status individual located outside the fortification wall, on the margin of the village: the so-called “Royal Tomb”.³¹ The tomb, containing an adult male in a stone cist richly furnished with metal objects and accompanied by four probably sacrificed adolescents, is likely to be the burial place of a political leader represented by war symbols and metals, and bearing objects explicitly referring to two different traditions: the old Mesopotamian-related tradition, and a new expanding North-Eastern Anatolian/Transcaucasian culture. Both the Royal Tomb and the fortification wall point to a period of intense intercultural contacts with the mountainous regions of the North East, and to possible conflicts during which a process of radical change was taking place in the Malatya region.³²

In period VI B2, there is again evidence for spinning activities, and from this time onwards, a change in the spindle whorls can be observed (figs. 12-13:a-h).

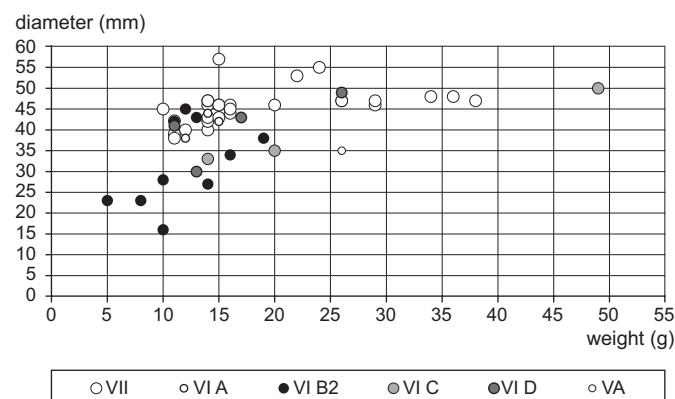


Fig. 12 – Chronological distribution of spindle whorls according to diameter and weight (N = 49).

Figure 12 shows that spindle whorls from period VII form one distinct group, and the spindle whorls from period VI B2 form another group. This suggests a shift in spinning practices and, by implication, in textile production.³³ There is a small, but significant, difference between period VII and period VI B2 in terms of the spindle whorls' weight and diameter: the weight of the whorls varies between 10-38 g during period VII, while it ranges between 5-20 g during period VI B2. In terms of diameter, the whorls vary between 38-57 mm during period VII, and between 15-45 mm during period VI B2. Thus, a larger variety of thinner yarns appears to have been produced in period VI B2. This indicates that the spinners in Arslantepe in period VI B2 were able to spin very thin but also less hard spun yarn in comparison to the earlier period VII. The change in the diameter of the whorl indicates that it was possible to produce a softer and more loosely spun yarn.

It would be unwise to assume that the production of coarser yarn ceased in period VI B2, but there is no trace of it in the archaeological material. The observed change in the textile tools may be due to several factors. The number of objects is small and not statistically representative. This said, the change is quite clear within the group of the recorded spindle

29. HALD, 1980: 240-278.

30. FRANGIPANE, 2001 and 2004: 106-107.

31. *Ibid.*, 2004: 106-107 and 2001: 60-67, figs. 12-13.

32. FRANGIPANE and PALUMBI, 2007.

33. The few spindle whorls (4 objects only) in the intermediate period VI A may belong to either the earlier group of whorls of period VII, or to the more recent VI B2 group.

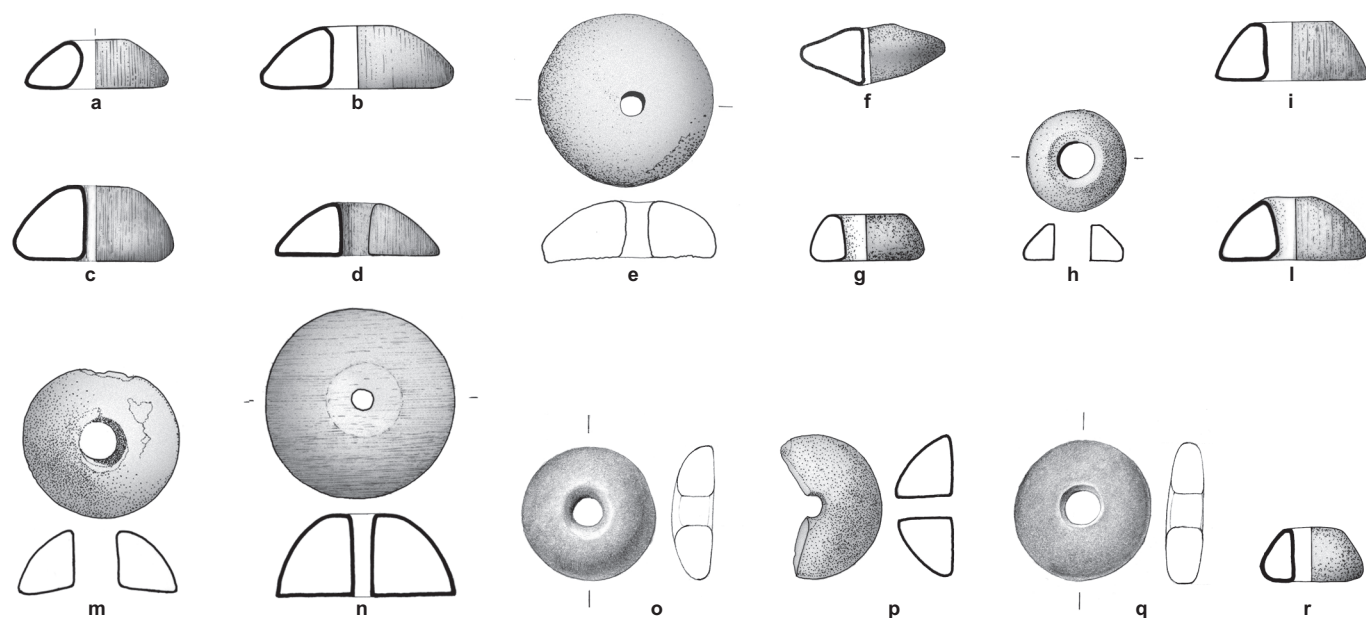


Fig. 13 – Arslantepe. **a**: bone spindle whorl from Arslantepe VI B1; **b-e**: bone spindle whorls from Arslantepe VI B2; **f**: spindle whorl in clay from Arslantepe VI B2; **g-h**: spindle whorls in stone from Arslantepe VI B2; **i-n**: bone spindle whorls from Arslantepe VI C and VI D; **o**: spindle whorl in stone from Arslantepe VI C; **p-r**: spindle whorl in stone from Arslantepe VI D. Scale 1:2. (Drawing treatment: T. D'ESTE; © Archive of the Italian Archaeological Mission in Eastern Anatolia – Sapienza University of Rome)

whorls. A possible explanation is a change in the fibre material. The spindle whorls from Arslantepe could be used for spinning both wool and linen yarn, but when spinning plant fibre, a spindle whorl with a large diameter is often preferred. Sheep's wool evolved during the Bronze Age,³⁴ and it is likely that the wool fibres became more varied in quality. This explanation is corroborated by the analysis of faunal remains from Arslantepe, which demonstrate a remarkable increase in goats and in particular sheep in the animal husbandry of period VI A and VI B.³⁵ As a result, the wool fibres could be sorted into several quality categories or mixed into a range of qualities and colours. This fibre change made it possible to produce yarn in a larger variety of qualities of either vegetal or animal fibres.

ARCHAEOLOGICAL TEXTILE FRAGMENTS FROM THE ROYAL TOMB OF PERIOD VI B

The unique presence at Arslantepe of textile fragments in the Royal Tomb sheds light on both textile production and funerary rituals.³⁶ The Royal Tomb was located in an isolated

position on the western side of the mound and was of considerable size, with elaborate construction features. It comprises a large pseudo-circular pit (S150) (fig. 14) and a cist grave (T1) lined with stone slabs (fig. 15). An adult male (H-225) was buried in the cist with very rich furnishings: 65 metal objects,³⁷ 2 necklaces, one calcite bowl, and 14 clay vessels, both wheel-made plain pots of the local Uruk-derived tradition and hand-made Red-Black wares of Transcaucasian type. The metal objects were mostly found in a hoard behind the back of the buried individual.

Both the body of the deceased and a part of the grave furnishings had been placed on a wooden board, of which several traces remain, and were probably covered by a funerary sheet, as was evidenced by the numerous traces of fabric visible and collected all over the cist. In particular, there were clusters of textile fragments at different points of the grave (figs. 14-15):

- above the remains of the wooden board;
- above and below the metal objects in the hoard, especially the metal vessels (samples 193/1998, 86/2002) and around dagger y19 (fig. 19);

34. RYDER, 1983.

35. BÖKÖNYI, 1983: tables 3-4.

36. FRANGIPANE *et al.*, 2001; PALUMBI, 2004.

37. 9 spearheads, 2 swords, 3 daggers, 4 axes, 2 chisels, 3 gouges, 2 vessels, 1 knife, 1 diadem and numerous ornaments.



Fig. 14 – Arslantepe (period VI B1). Royal Tomb. Plan of the upper burials with the four individuals on the top of the cist grave. Traces of textile are indicated with circles in grey. (Plan: C. ALVARO; drawing treatment: A. SIRACUSANO; © Archive of the Italian Archaeological Mission in Eastern Anatolia – Sapienza University of Rome)

- below pots x10, x12 and x13 (samples 309/1996, 373/1996);
- close to the shoulder of the deceased, below the two necklaces;
- close to the left tibia.

The location of the textile finds suggests that one or more fabrics were wrapped around and/or covered the body and his grave goods.

Textile (Sample 309/1996)³⁸

Nine fragments were analysed by A. Rast-Eicher and S. Möller-Wiering. All of them consist of many layers of an extremely fine fabric (fig. 16). Some sections are light brown in colour, others darker to almost black. The material looks like bundles of vegetal fibres, but the fibre could not be absolutely identified. The surface is often disturbed or concealed by

38. Analysis by S. Möller-Wiering.

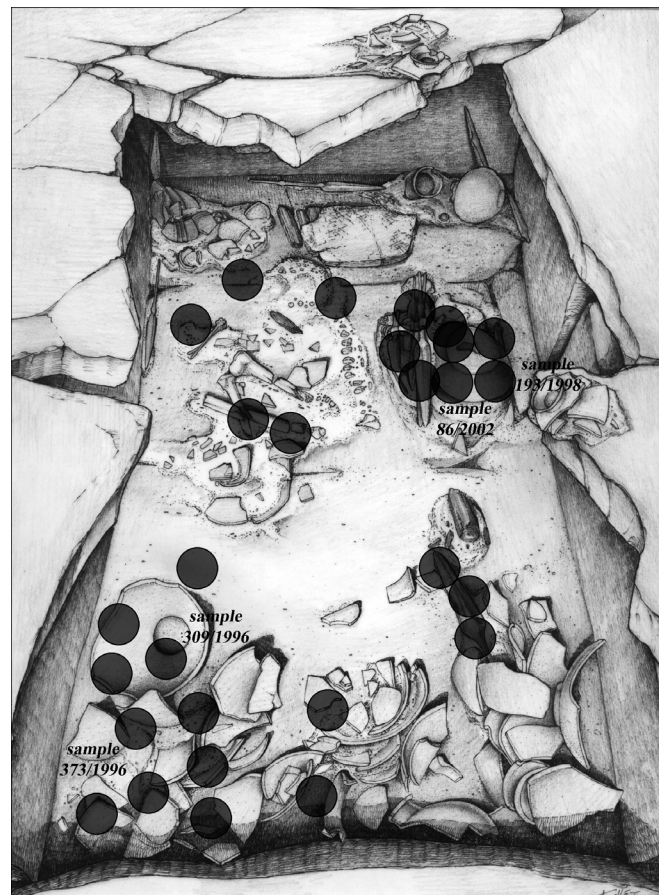


Fig. 15 – Arslantepe (period VI B1). Royal Tomb. Plan of the interior of the cist grave with materials in situ. Traces of textile are indicated with circles in grey. (Plan: C. ALVARO; 3D drawing: T. D'ESTE; © Archive of the Italian Archaeological Mission in Eastern Anatolia – Sapienza University of Rome)

plaster, which makes it difficult to follow the threads and the textile layers. The structure is tabby with rather straight yarn in one system (B), while the threads of the other system (A) are wavy in a regular way, which results in a rounded pattern (fig. 17). Measurements could be taken only along extremely short distances, using a magnification of 25x. On the largest fragment, system A counted five threads within a distance of *ca* 1.33 mm, corresponding to *ca* 38 threads per cm. For system B, the respective figures are five threads within a distance of 2.78 mm and thus giving a thread count of *ca* 18 threads per cm. The thickness of the yarns in system A was measured to *ca* 0.084 mm, in system B it was *ca* 0.114 mm, but it might have been somewhat thicker originally. The yarn is slightly s-twisted. The measurements on the other fragments

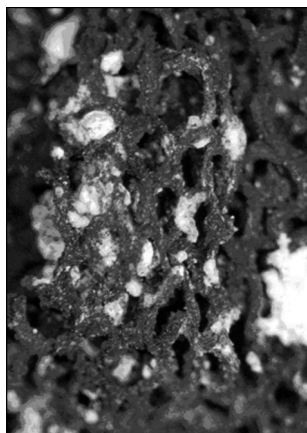


Fig. 16 – Sample 309/1996; microscopic photo. (Photo: S. MÖLLER-WIERING)

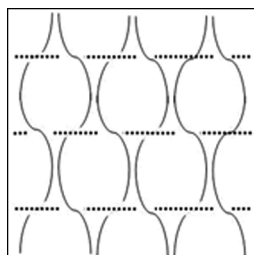


Fig. 17 – Sample 309/1996; sketch of the principle of the weave.

gave similar results. In conclusion, this textile is of an extreme fineness, of 18 to 38 threads per cm² and very thin threads. It is either weft-faced or warp-faced.

Plaster with Textile (Sample 373/1996)³⁹

Eighteen fragments were examined. The largest of these fragments measures ca 1.7 x 1.5 cm. Many of them contain some fibre-like material but no textile structures could be identified.

Oxidised Textile on Metal Bowl y3 (Sample 193/1998)⁴⁰

Several woven fragments with a maximum size of 2.7 x 0.6 cm were examined. The fibre material cannot be identified

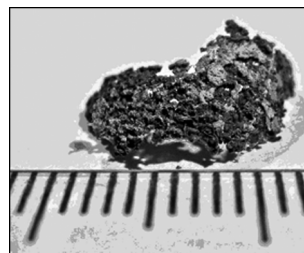


Fig. 18 – Sample 193/1998, photographed from an oblique angle.

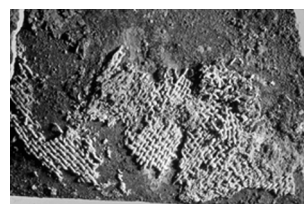


Fig. 19 – Arslantepe (period VI B1), textile fragments on a diadem from the Royal Tomb. (Photo: R. CECCACCI © Archive of the Italian Archaeological Mission in Eastern Anatolia – Sapienza University of Rome)

(fig. 18). The fragments adhere to the metal bowl y3. The fine fabric of light greyish-brown colour is a tabby. The weaver used s-spun yarn of ca 0.3 mm thickness for both thread systems. The balanced thread count—measured only over distances of 3 mm or less—was calculated as ca 16-17 threads per cm in the warp as well as in the weft.

Piece of Textile on Metal Bowl y3 (Sample 086/2002)⁴¹

This textile is in a mineralised state. The sample shows very fine s-spun threads of an exceptionally thin diameter of 100 µ (fig. 19). The threads are definitely spun and not plied. One direction seems looser spun, and may therefore be the weft. The threads in both directions (weft and warp) are made of a fine, animal fibre, of a diameter of 10 µ (fig. 20). The scale pattern on the fibre surface demonstrates that it is a fibre from sheep's or goat's wool. The scales are not very thick, and the fibres are therefore probably from goat's wool (fig. 21).

39. Analysis by S. Möller-Wiering.

40. *Idem*.

41. Analysis by A. Rast-Eicher, Archeotex, Spring 2008.

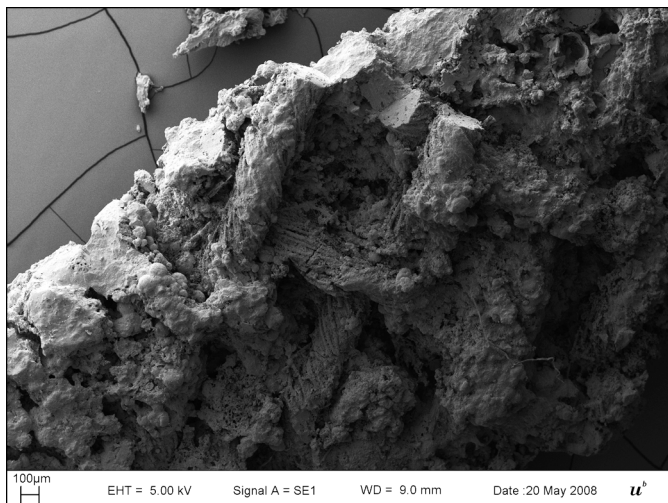


Fig. 20 – Sample 086/2002; microscopic photo.
(Photo: A. RAST-EICHER)

Furthermore, the scales are interrupted, again an indication of goat's wool fibre, since very fine sheep's wool fibres tend to embrace the whole fibre. Since the thread is spun and not plied, the fibres must have been of a certain length—short fibres would be difficult to spin without plying in such a fine quality for a warp thread, which has to be sufficiently strong to hold in a weave. In conclusion, an exceptionally fine quality of fabric made from probably goat's wool fibres and thus one of the oldest attestations of animal fibre in a textile in the Near East.

The rank of the deceased is also indicated by the presence of four probably sacrificed young people on the stone slabs covering the cist grave. Their bodies were in unnatural positions, and it is assumed that they died in states of suffering.⁴² Both a girl (H-224) and a boy (H-223) wore two copper pins, two hair spirals, and a diadem in copper-silver alloy. Both adolescents were probably wearing a cloth and a veil fixed by the diadem as indicated by the remains of fabric under the boy's diadem and the fragments of textiles identified on metal pins around which thread had been wound, perhaps to sew up their clothing. Two other young girls (H-221 and H-222) were found at the feet of the first couple and were probably of an inferior rank, since their position in the grave is marginal and they are totally lacking equipment.

42. SCHULTZ and SCHMIDT-SCHULTZ, 2001 and 2004.

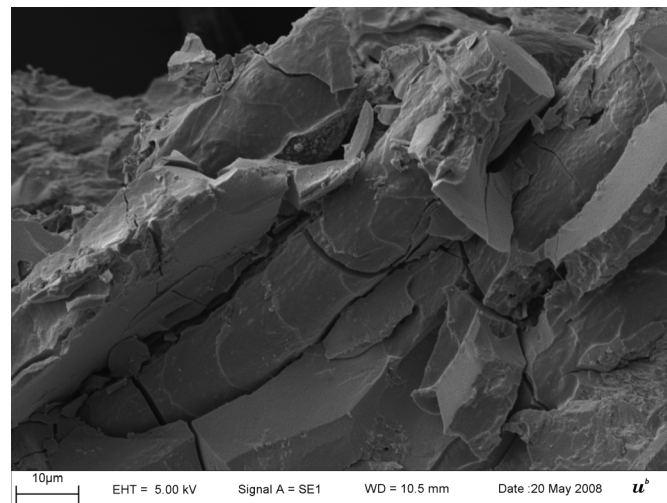


Fig. 21 – Sample 086/2002; microscopic photo showing the scales on the fibre. (Photo: A. RAST-EICHER)

FINDS FROM BUILDING IX

Another find of relevance from period VI B2 is an example of a mat woven from grass and found in room A170 in Building IX.⁴³ Building IX is of domestic usage and composed of five rooms (fig. 22). Room A170 and two other areas were clearly used for the processing of cereals. A huge quantity of burnt seeds have been found in A170 and in the adjacent streets A355 and A199, suggesting that cereals were also placed on the open roof of Building IX. A few spindle whorls were found in A170 and A200 suggesting that spinning was also one of the daily domestic activities in period VI B2.

A Mat of Plant Fibres (Sample 191/1985)⁴⁴

The mat is made of interwoven vegetal fibres of a grass (*gramineae*) with short and long cells, which are typical for *gramineae*. This sample shows distinctly undulated cell walls. It looks very much like wheat, but no stomata are visible and thus no further conclusions can be drawn.

43. Traces of interwoven mat have also been found and collected (Sample 214/1985) in A329 (Building XX), a room in front of A170 on the opposite side of the street A355.

44. Analysis by A. Rast-Eicher, Archeotex, Spring 2008.

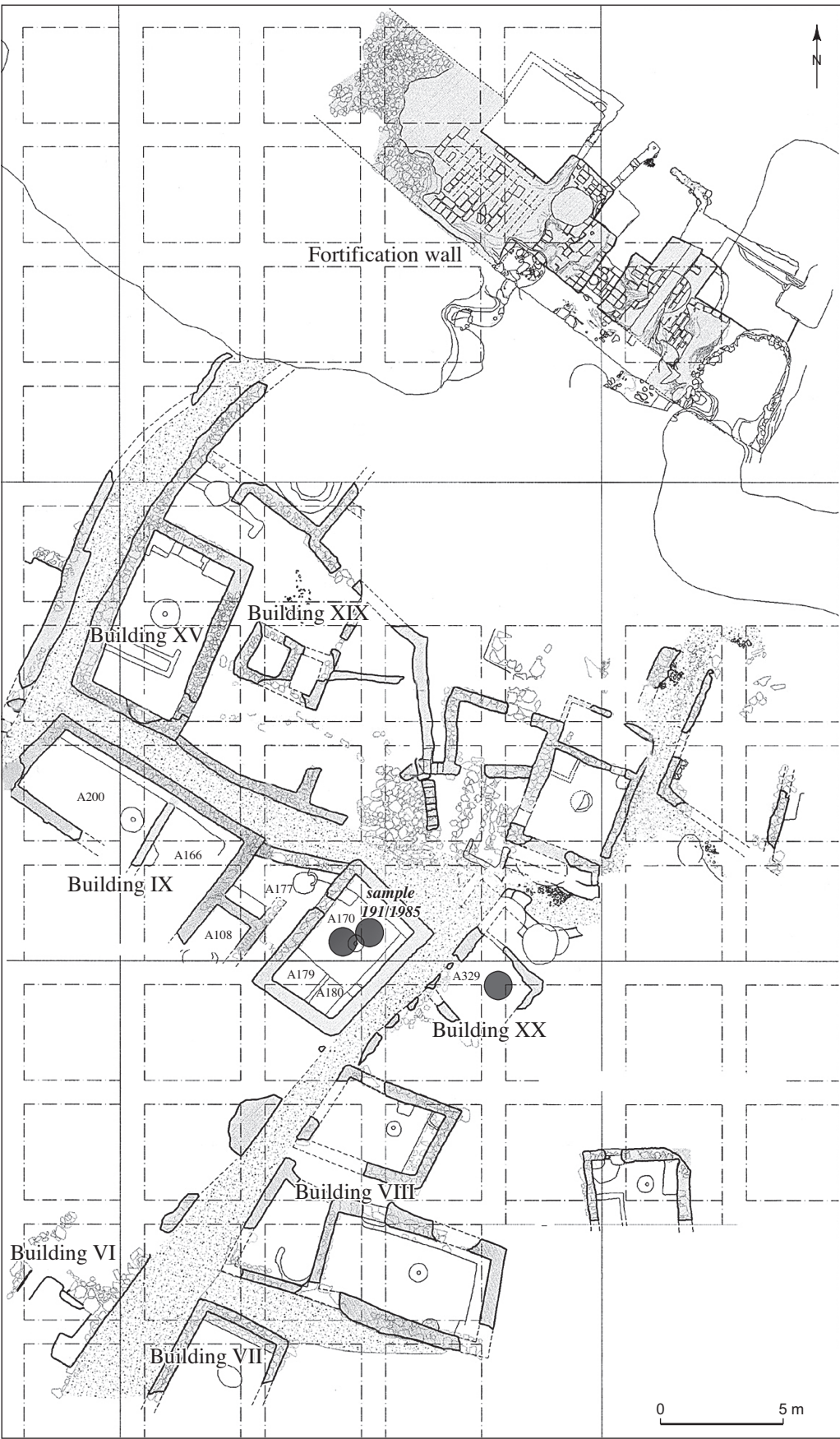


Fig. 22 – Arslantepe
(period VI B2). General plan
of the village. Traces of inter-
woven vegetal fibres are indi-
cated with circles in grey. (Plan:
C. ALVARO; © Archive of the
Italian Archaeological Mission
in Eastern Anatolia – Sapienza
University of Rome)

TEXTILE PRODUCTION IN ARSLANTEPE IN PERIODS VI C (2750-2500 BCE) AND VI D (2500-2000 BCE)

During the following VI C period (Early Bronze II, 2750-2500 BCE), the history of the site was interrupted, as were its relations with the Mesopotamian world. In this period, Arslantepe became one among many small and maybe seasonal sites of the Malatya plain. Only a few textile tools have been retrieved from period VI C, and they come exclusively from pits and filling layers.

The situation in the second half of the 3rd millennium BCE (Arslantepe VI D, Early Bronze III) is different in that a new, well-organised settlement began to develop within the new Eastern Anatolian cultural tradition.⁴⁵ The house plan changed completely, as did the majority of the domestic features. In sub-phase VI D1 (Early Bronze IIIA), large, quadrangular, multi-roomed houses were built on terraces on the upper part of the mound in a relatively dispersed arrangement. After new episodes of probably seasonal frequentation of the site by groups using oval, semi-subterranean buildings and circular huts, the settlement expanded onto the hill slopes again during the last phases of period VI D (sub-phase VI D2, Early Bronze IIIB). Large quadrangular houses of the same type found in sub-phase VI D1 were grouped in blocks separated by alleys and open courtyards, according to a fairly close settlement layout. New terraces were built and a massive mud-brick and stone defence wall with round buttresses/towers surrounded the site.

In this fortified town, a number of locations were used for specialised production such as metallurgy and textile work. The specialised textile activity is testified by many and various textile tools never attested before at Arslantepe. Spindle whorls had many different shapes and were made of a wide selection of raw materials (fig. 13). New textile tools appeared: combs made of bone, clay brushes (possibly used to remove the last parts of the broken stems during the preparation of vegetal fibres), and spools. Only two clay spools are known from the previous periods VII and VI A. But the four spools from period VI D are smaller and lighter (fig. 23). The function of these tools is not clear. They are very light (5-40 g) and are therefore unlikely to have been used on a loom. They were perhaps used as simple spools for winding up yarn, or as weights in a band weave, or for warping the loom.

45. CONTI and PERSIANI, 1993.

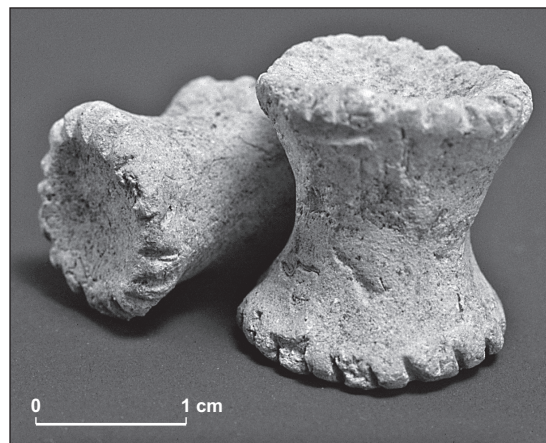


Fig. 23 – Spools ARS-219 and 220 (period VI D2).
(Photo: R. CECCACCI; © Archive of the Italian Archaeological Mission in Eastern Anatolia – Sapienza University of Rome)

In period VI C-D, loom weights are rare,⁴⁶ maybe suggesting the existence or the coexistence of different loom types other than the warp-weighted loom; in particular, looms not requiring loom weights such as the two-beam loom or the horizontal ground loom. It is also possible that weaving with warp weights took place in other sectors of the town.

TEXTILE PRODUCTION IN PERIOD V A (2000-1750 BCE)

Most of the evidence from period V A (Middle Bronze Age, 2000-1750 BCE) has been brought to light in the upper part of the mound. Few complete domestic structures in the tradition of the previous Early Bronze III B architectural typology have been unearthed. A variety of textile tools is attested: spindle whorls, loom weights, brushes, various pointed tools, needles, spools, beaters and pin beaters.

The most interesting complex of this period is a large, well-preserved house, at the core of which was a very large quadrangular room (A58) containing an imposing central hearth with a double horseshoe-shaped shoulder.⁴⁷ The collapse of the structure due to a fire probably killed a woman whose skeleton was found on the floor close to the hearth. The house

46. Only three loom weights were found from period VI C and VI D.

47. PALMIERI, 1973; DI NOCERA, 1998.

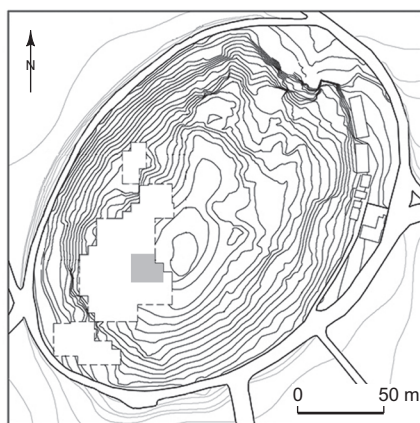
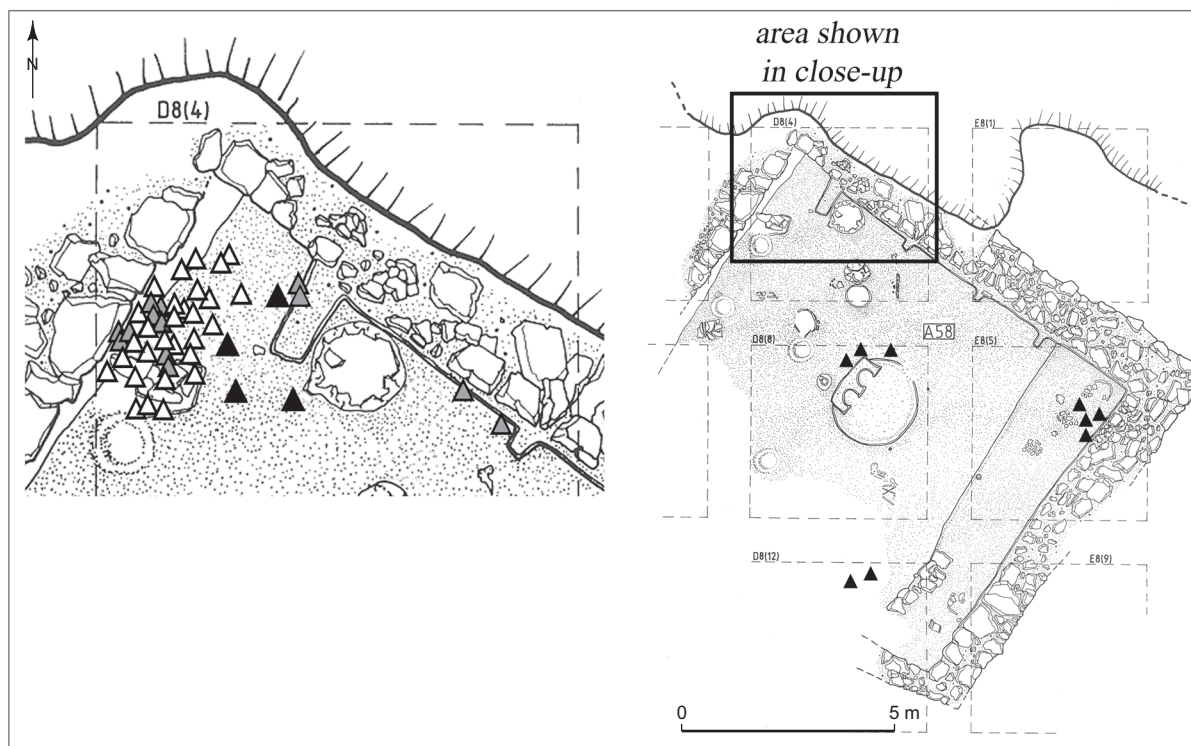


Fig. 24 – Arslantepe (period V A). Plan of room A58 with the loom weights distribution. ▲ loom weights found on the first floor P1; △ loom weights found on the second floor P2; △ loom weights found during the removal of the second floor P2. (© Archive of the Italian Archaeological Mission in Eastern Anatolia – Sapienza University of Rome)



contained numerous storage jars and domestic items. Fifty-five loom weights were found in a corner of this room (fig. 24), coming from at least two succeeding sub-phases, floor P1 and floor P2.⁴⁸

This extraordinary find suggests that a loom was located in this area of the house and was repeatedly placed and used in

48. Thirteen of the loom weights were found on the first floor and 42 were found on the second floor or in its debris.

the same position in various rebuilding phases of the structure. These loom weights show radical changes in type, thickness and weight compared to the previous periods (figs. 25-26).

The chronological distribution of different types of loom weights demonstrates a clear change in the shapes of the loom weights over the course of time: 18 of the 23 loom weights belonging to period VII are hemispherical; 17 of the 21 loom weights dating to period VI A are conical; and, finally, 36 of the 42 loom weights from period V A (level P2) are discoid elliptical.

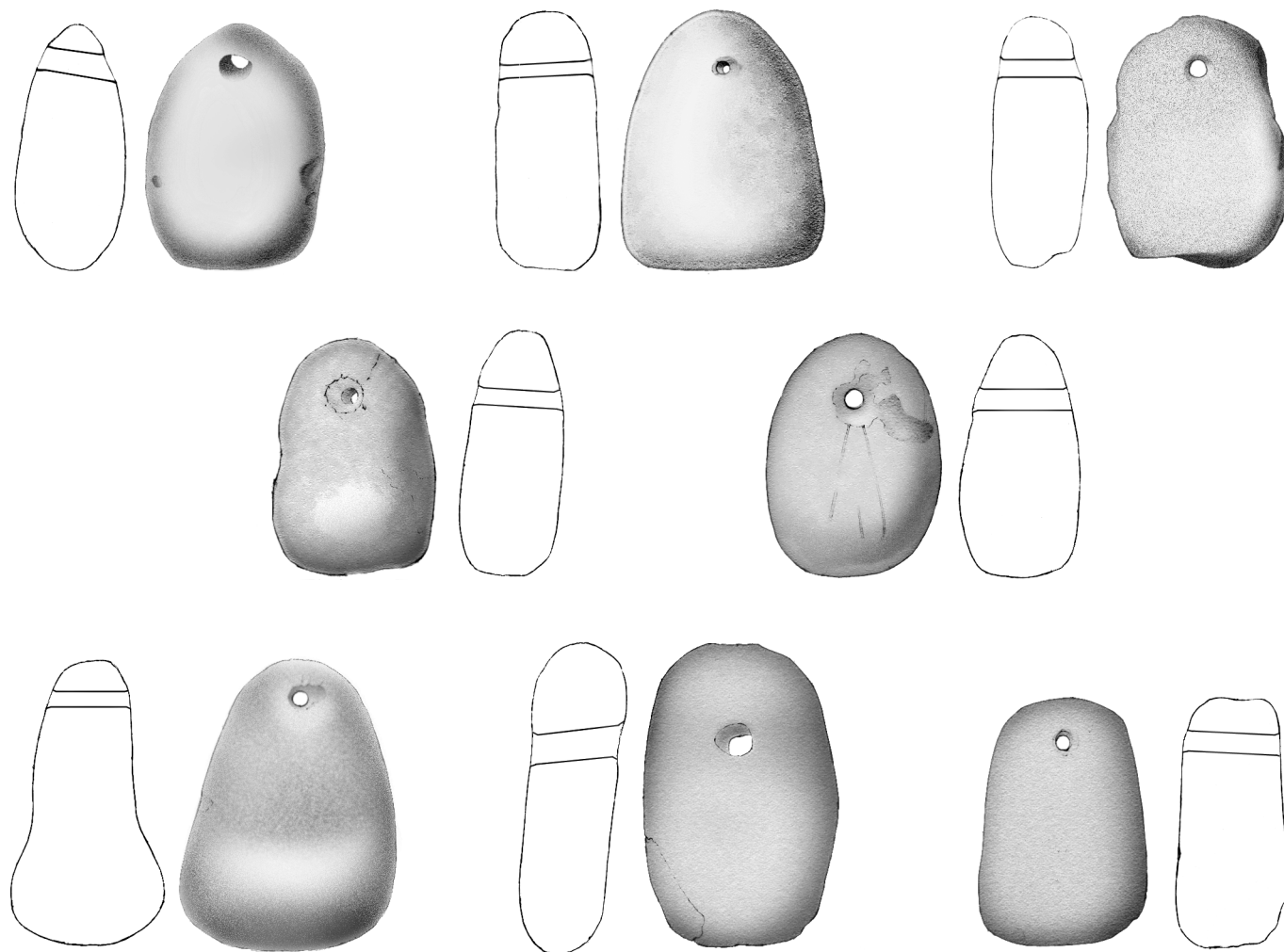


Fig. 25 – Arslantepe. Loom weights from A58 (period V A). Scale 1:3. (Drawing treatment: T. D'ESTE;
© Archive of the Italian Archaeological Mission in Eastern Anatolia – Sapienza University of Rome)

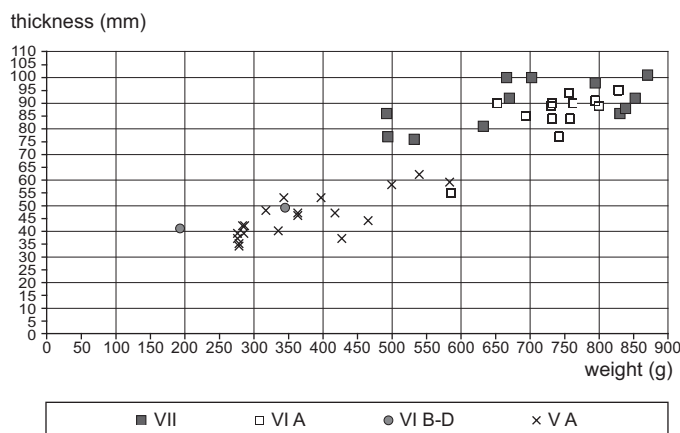


Fig. 26 – Chronological distribution of loom weights according to weight and thickness ($N = 47$).

In the following, the focus is on the 42 loom weights found on floor P2 of A58 or in its debris.⁴⁹ The majority of the loom weights are made of fired clay and are discoidal elliptical in shape. Their weight varies from 277-584 g and their thickness from 37-59 mm. Thus, they are both lighter and thinner than the loom weights from the previous periods. With this type of loom weight it is possible to produce denser fabrics (up to 16 warp threads per cm) with thinner threads that only need a warp tension of 10 g/thread. However, these loom weights could also produce the same fabrics as the earlier, heavier and thicker loom weights from period VII (app. 5 warp threads per cm).

49. Information on weight and thickness is available on 16 loom weights from the second floor, P2.

Table 6 – Calculation of various loom setups with loom weight ARS-139 (weight 279 g, thickness 3.5 cm).

Warp threads requiring	10 g warp tension	20 g warp tension	30 g warp tension	40 g warp tension
Number of warp threads/loom weight	28	14	9	7
Warp threads/cm	16	8	5	4
Technical evaluation of the tool's suitability	Best suitability	Best suitability	Best suitability	Possible

On the basis of one of the loom weights from this context (ARS-139), various loom setups can be calculated, suggesting which setups and fabrics would be the most likely. The calculations are based on a balanced tabby of 100 x 200 cm.

Table 6 demonstrates that a yarn requiring 10 g warp tension results in a fabric with 16 warp threads per cm. Thus, a fabric of a width of 100 cm would need 1,600 warp threads. Each loom weight of 279 g should hold 28 warp threads, and thus 56 looms would be needed for this set-up. This gives a yarn consumption of 3,200 m warp, 3,200 m weft, thus a total of 6,528 m. It would take approximately 186 hours to spin the yarn, if spun on a spindle with a whorl of 4 g.⁵⁰ The time consumption and thread density suggest that this must have been a very valuable piece of cloth.

The calculations also demonstrate that this loom weight could be very functional for quite a number of different fabrics with a variety of yarn qualities. Yet, a setup of this type requires a large number of loom weights, in this case at least 56 loom weights, to produce a fabric with a width of 100 cm. Weaving a coarse fabric with so many loom weights would be impractical and even counterproductive. Therefore, it can safely be assumed that for a coarser textile of thicker threads, a weaver would choose thicker and heavier loom weights. This leads to the conclusion that the use of thin, light loom weights, such as ARS-139, would be a deliberate choice by the weaver to produce a specific type of fabric, namely a densely woven fabric of very thin threads requiring low warp tension.⁵¹

In period V A, the loom weights changed radically in terms of type, thickness and weight. It is important to note, however, that even though these loom weights differ from previous periods, it is still possible to produce the same types of fabric with them. Their new advantage is that they made it possible to produce denser fabrics and fabrics with thinner threads requiring a warp tension of only 10 g/warp thread.

50. ANDERSSON *et al.*, 2008.
51. MÄRTENSSON *et al.*, 2009.

CONCLUSIONS ON TWO MILLENNIA OF TEXTILE PRODUCTION AT ARSLANTEPE

The contextual analysis of the textile tools has demonstrated that loom weights and spindle whorls are never found together in the same room or area in Arslantepe. In addition, there is no evidence so far of proper workshop areas where animal and/or vegetal fibres were collected, processed, washed, spun and woven into textiles. Spinning and weaving activities seem to have taken place in household contexts alongside other domestic activities. No firm connection between the textile activities and a central management in the palatial sphere is apparent. However, the variety evident in the textile production and the good quality of the textile tools in all periods at Arslantepe suggest a high level of spinning and weaving technologies and the presence of skilled spinners and weavers.

SPINNING TECHNOLOGY

The present analysis is based on a total of 88 spindle whorls, of which 74 come from stratified layers: 40 spindle whorls belong to period VII, 8 spindle whorls belong to period VI A, 14 belong to period VI B, 10 belong to periods VI C-D, and 2 are dated to period V A (table 1). In all periods, from VII to V A, spindle whorls mainly derive from household contexts, with few exceptions (table 1). In period VII, there is no significant variation in weight and diameter between spindle whorls found in household contexts, pits or other contexts. From period VI A onwards the spindle whorls found in household contexts are concentrated in the weight range of 10-20 g, whereas whorls discovered in pits and other contexts display a greater weight distribution. Finally, though the spindle whorls found in period VI A are very few, there is no significant variation between those found in the palace area and those in the settlement area of the same period.

Table 7 – Chronological distribution of spindle whorls according to shape and material. Please note that only spindle whorls made of clay, stone and bone are included.

		Clay	Stone	Bone
VII	Spherical		1	
	Convex	1		17
	Discoid		7	
	Conical	1		10
	Biconical	1		1
VI A	Convex			4
	Discoid		1	
	Cylindrical		1	
VI B1	Convex			1
	Conical			1
VI B2	Spherical			
	Convex		2	3
	Discoid			
	Conical		2	
	Biconical	4		1
VI C	Conical		2	1
	Biconical	1		
VI D	Convex		1	2
	Discoid			
	Conical			2
	Biconical			1
V A	Spherical	1		
	Convex			1

Table 8 – Chronological distribution of loom weights according to shape and material.

		fired clay	unfired clay
VII	hemispherical		18
VI A-VI B1	conical	17	
	discoid elliptical	1	
	hemispherical	1	
	spherical ovoid	2	
VI B2-VI D	discoid elliptical	2	
	spherical ovoid	1	
V	discoid elliptical	28	8
	flat rectangular	2	2
	flat trapezoidal	2	
	hemispherical	1	1

Starting from period VI A, the material used for making spindle whorls changed slightly. A wider use of raw material is in particular observed during period VI B2, when there is an equal distribution of spindle whorls made of clay, stone and bone (table 7).

The whorls vary in weight from 5-49 g and their diameter varies from 23-55 mm (see fig. 12 above). During period VII, all whorls weighing less than 26 g are made of bone, whereas during the following periods, the light whorls are also made of other materials such as clay and stone. These light clay and stone whorls of periods VI-V, however, have a smaller diameter than the bone whorls of the previous period VII.

The analysis also provides evidence of a change in the variety of spinning tools from the 4th to the 2nd millennium, clearly recognisable from period VI B2 (Early Bronze I). The whorls of period VII are 10-38 g in weight and 38-57 mm in diameter; whereas the whorls of the following periods range from 5 to 49 g and from 23 to 50 mm in diameter. The wider range of weights and diameters in the spinning tools of periods VI-V A suggests that there may have been a change in the textile production with a larger variety of yarns being produced in the later periods.

Spindle whorls from period VII form a distinct group (see fig. 12 above) and this is also the case with the spindle whorls from period VI B2. This suggests a shift in spinning practice, and, consequently, in textile production, starting from period VI B2. The diameter of the whorls from period VII is generally quite large, indicating that the yarn must have been quite hard spun. Vegetal fibres require harder twist and we suggest that the whorls reflect the vegetal fibre processing dominating the textile production in the 4th millennium. Whorls become lighter and smaller in period VI B2, suggesting an increase in animal fibres and that very thin and less hard spun yarn could now be produced.

WEAVING TECHNOLOGY

All 23 loom weights from period VII are made of unfired clay. In contrast, the majority of the loom weights (19 out of 21 objects) belonging to period VI A are made of fired clay, as are also the few examples dated to periods VI B, C, and D. The same trend can be seen in period V A, where the majority of the loom weights (38 of 66 objects) are made of fired clay and only 11 items are made of unfired clay (table 8). The analysis further demonstrates a clear change in the shapes of the loom weights over the course of time: 18 of the 23 period VII loom weights are hemispherical; 17 of the 21 loom weights are conical.

cal in period VI A; and, finally, in period V A, 36 of 42 loom weights are discoid elliptical.

However, the main assemblages of loom weights found at Arslantepe come from single homogeneous contexts: the 23 loom weights from period VII all derive from “area A923”; the 18 loom weights dated to period VI A have been found in one single room, namely “residential room A933 in Square D7 (2)”; and no less than 55 of the 66 loom weights belonging to period V A are from two superimposed assemblages found in two successive floors of the same “room A58”, in “Square D8 (4)”. Thus, we are dealing with three distinct contexts—and probably looms—belonging to three periods. The differences in material and type between the three periods therefore may not necessarily only represent a change over time or a change in production, but may also reflect the different nature of the three contexts and different types of textile production.

DEVELOPMENTS IN THE TEXTILE TECHNOLOGY

In period VII, the weavers in Arslantepe produced fabrics with 5-6 warp threads and the same number of weft threads (in tabby) or more weft threads (in a weft-faced fabric). A relatively coarse warp yarn with 30 g tension/warp thread seems to have been the most suitable type, at least for the preserved loom weights from the period. In period VI A, loom weights from a domestic context indicate the continuation of a similar production of fabric of *ca* 6 threads/cm². The archaeological remains of textiles from period VI B, found in the so-called Royal Tomb, however, tell another story: here we find an exceptional fabric quality with a thread count of up to 38 threads/cm². In period V A loom weights, a wider range of weights and thicknesses can be observed, but, generally speaking, the loom weights found in periods VI B2-V A have become lighter and thinner compared to period VII. The tools from period VII are suitable for fabrics with 4-6 warp threads per cm, whereas those belonging to period V A are suited to the production of a wider range of fabrics with up to 16 warp threads per cm. Thus, the variation in production of different qualities of threads and fabrics increased during the later period. The traditional cloth qualities of period VII were maintained, but the repertoire of qualities expanded during periods VI and V A.

In terms of spinning activities, a change in the size of spindle whorls was observed from phase VI B2, with whorls becoming lighter and smaller, suggesting that very thin and less hard spun yarn could now be produced. The changes in the loom weights observed in period V A, when loom weights also became lighter and thinner, allowed the production of denser

fabrics with very thin threads. This suggests an increased variation in production of different qualities of threads and fabrics during the later periods. Unfortunately, there are only two spindle whorls from period V A and four loom weights from period VI B-D. Therefore it is impossible to determine whether the changes in spinning and weaving coincided chronologically. For the time being, it seems that the new animal fibres first influenced the size, weight and diameter of the spinning tools, and only subsequently resulted in the modification of the weaving tools. It should also be noted that it is much more time-consuming to produce the finer threads and fabrics.

The spinners and weavers in Arslantepe were skilled craftspeople; they knew how to spin and how to weave and which tools to use to produce specific qualities.

The combination of textile tool studies and faunal analyses has promising perspectives and potentials: it allows for more precise identification of the fibre changes and the introduction of animal fibres in the textile production in the 4th millennium.⁵² In addition, the textile tool analysis represents a useful method to shed light on the nature and role of animal husbandry in a given society and to infer the availability of vegetal and animal fibres on sites where faunal, floral and textile remains are absent or not analysed. Thus, the increased sheep/goat rearing and access to animal fibres in periods VI A and VI B2 at Arslantepe correspond to a change in the spinning tools (clearly visible in period VI B2), which would respond well to the properties of the softer animal fibres.

Equally important is the combination of textile tool studies and analysis of actual textile remains in the fortunate cases in which they are preserved: it allows for a more precise understanding of the textile production, its qualities and limitations. Textile remains indeed represent an excellent opportunity to verify the methodologies of textile tool studies; they provide insight both into the weaving techniques and the fibre material. The analysis carried out on the preserved textile fragments from the “Royal Tomb” at Arslantepe reveals one of the world’s oldest pieces of what is probably a goat’s wool textile, dated to 3000-2900 BCE.⁵³ The only other very early example of a textile made from animal fibres, from the Nahal Mishmar Cave, Israel, is dated to the middle of the 4th millennium.⁵⁴

The textile analysis also points to the complexity of available textile technologies, often far more advanced than the

52. MCCORRISTON, 1997. For a discussion, see HUOT, 2000.

53. On the use of fibres from goats, see RYDER, 1993.

54. BAR-ADON, 1980. However, see also the discussion of possible archaeozoological evidence for Neolithic use of animal fibres in textile production in HELMER, 1999.

hypothetical technical loom setup calculations. The thread count of 38 threads/cm² illustrates the technical skill and complexity of textile technologies achieved at the site at the beginning of Early Bronze I.

ACKNOWLEDGMENTS

This paper was written with the support of the Culture Programme of the European Union, the Danish National Research Foundation, and the Danish Research Council for the Humanities. Figure 11 was generously provided by textile engineer J. Boutrup, Designskolen Kolding, Denmark, and textile technician and archaeologist L. Olofsson made experiments for this paper. The authors also thank the anonymous reviewers for constructive comments and suggestions.

Romina LAURITO

Marcella FRANGIPANE

Dipartimento di Scienze Storiche

Archeologiche e Antropologiche dell'Antichità

Università di Roma "La Sapienza"

Piazzale Aldo Moro 5

00185 Roma – ITALY

marcella.frangipane@uniroma1.it

rominalaurito@hotmail.com

Eva ANDERSSON STRAND

Susan MÖLLER-WIERING

Marie-Louise NOSCH

Agnete WISTI LASSEN

The Danish National Research Foundation's Centre for Textile Research

SAXO Institute

University of Copenhagen

Norregade 10

1165 Copenhagen K – DANEMARK

evaandersson@hum.ku.dk

smw@archaeologie-und-textil.de

nosch@hum.ku.dk

alassen@hum.ku.dk

Antoinette RAST-EICHER

Archeotex

Kirchweg 58

8755 Ennenda – SUISSE

info@archeotex.ch

BIBLIOGRAPHY

- ANDERSSON E., MÅRTENSSON L., NOSCH M.-L. and RAHMSTORF L.
2008 New Research on Bronze Age Textile Production. *Bulletin of the Institute of Classical Studies* 51: 171-174.
- BAR-ADON P.
1980 *The Cave of the Treasure: The Finds from the Caves in Nahal Mishmar*. Jerusalem: Israel Exploration Society (*Judean Desert Studies*).
- BÖKÖNYI S.
1983 Late Chalcolithic and Early Bronze I Animal Remains from Arslantepe (Malatya), Turkey: A Preliminary Report. *Origini* 12,2: 581-598.
- BRENIQUET C.
2008 *Essai sur le tissage en Mésopotamie des premières communautés sédentaires au milieu du III^e millénaire avant J.-C.* Paris: De Boccard (*Travaux de la Maison René-Ginouvès* 5).
- CONTI A.M. and PERSIANI C.
1993 When Worlds Collide. Cultural Developments in Eastern Anatolia in the Early Bronze Age. In: FRANGIPANE M., HAUPTMANN H., LIVERANI M., MATTHIAE P., MELLINK M. (eds.), *Between the Rivers and over the Mountains*. *Archaeologica Anatolica et Mesopotamica: Alba Palmieri Dedicata*: 133-161. Roma: Università di Roma "La Sapienza".
- DI NOCERA G.M.
1998 *Die Siedlung der Mittelbronzezeit von Arslantepe*. Roma: Università di Roma "La Sapienza".
- FRANGIPANE M. (ed.)
2004 *Alle origini del potere. Arslantepe, la collina dei leoni*. Rome: Electa.
2007 *Arslantepe. Cretulae. An Early Centralised Administrative System before Writing*. Roma: Università di Roma "La Sapienza" (*Missione Archeologica Italiana nell'Anatolia Orientale, Arslantepe V*).
- FRANGIPANE M.
1993 Local Components in the Development of Centralized Societies in Syro-Anatolian Region. In: FRANGIPANE M., HAUPTMANN H., LIVERANI M., MATTHIAE P., MELLINK M. (eds.), *Between the Rivers and over the Mountains*. *Archaeologica Anatolica et Mesopotamica: Alba Palmieri Dedicata*: 133-161. Roma: Università di Roma "La Sapienza".
1997 A 4th Millennium Temple/Palace Complex at Arslantepe-Malatya. North-South Relations and the Formation of Early

- State Societies in the Northern Region of Greater Mesopotamia. *Paléorient* 23,1: 45-73.
- 2000 Origini ed evoluzione del sistema centralizzato ad Arslantepe: dal "tempio" al "palazzo" nel IV millennio a.C. *ISIMU* 3: 53-78.
- 2001 The Transition between Two Opposing Forms of Power at Arslantepe (Malatya) at the Beginning of the 3rd Millennium. *TÜBA-AR* 4: 1-24.
- 2002 'Non-Uruk' Developments and Uruk-linked Features on the Northern Borders of Greater Mesopotamia. In: POSTGATE N. (ed.), *Artefacts of Complexity: Tracking the Uruk in the Near East*: 123-148. Oxford: Aris and Phillips (*British School of Archaeology in Iraq – Iraq Archaeological Reports* 5).
- FRANGIPANE M. and PALMIERI A.
- 1983 Cultural Developments at Arslantepe at the Beginning of 3rd Millennium. In: FRANGIPANE M. and PALMIERI A. (eds.), *Perspectives on Protourbanization in Eastern Anatolia: Arslantepe (Malatya). An Interim Report on 1975-1983 Campaigns*. *Origini* XII/2: 523-574.
- FRANGIPANE M. and PALUMBI G.
- 2007 Red-Black Ware, Pastoralism, Trade, and Anatolian-Transcaucasian Interactions in the 4th-3rd Millennium BC. In: LYONNET B. (éd.), *Les cultures du Caucase (VI^e-III^e millénaires avant notre ère). Leurs relations avec le Proche-Orient*: 233-255. Paris: CNRS Éditions.
- FRANGIPANE M., DI NOCERA G.M., HAUPTMANN A., MORBIDELLI P., PALMIERI A., SADORI L., SCHULTZ M. and SCHMIDT-SCHULTZ T.
- 2001 New Symbols of a New Power in a "Royal" Tomb from 3000 BC Arslantepe, Malatya (Turkey). *Paléorient* 27,2: 105-139.
- HALD M.
- 1980 *Ancient Danish Textiles from Bogs and Burials. A Comparative Study of Costume and Iron Age Textiles*. Copenhagen: The National Museum of Denmark.
- HELMER D.
- 1999 Origine e sviluppo dell' allevamento nel Vicino Oriente. *La ricerca folklorica* 40: 25-30.
- HUOT J.-L.
- 2000 Existe-t-il une «révolution de la laine» au début de l'âge du Bronze oriental? In: MATTHIAE P., ENEA A., PEYRONEL L. and PINNOCK F. (eds.), *Proceedings of the 1st International Congress on the Archaeology of the Ancient Near East, Rome, May 18th-23rd, 1998*: 640-642. Roma: Università di Roma "La Sapienza".
- LAURITO R.
- 2007 Ropes and Textiles. In: FRANGIPANE M. (ed.), *Arslantepe. Cretulae. An Early Centralised Administrative System before Writing*: 381-394. Roma: Università di Roma "La Sapienza" (*Missione Archeologica Italiana nell'Anatolia Orientale, Arslantepe V*).
- MÅRTENSSON L., NOSCH M.-L. and ANDERSSON E.
- 2009 Shape of Things: Understanding a Loom Weight. *Oxford Journal of Archaeology* 28,4: 373-398.
- MCCORRISTON J.
- 1997 The Fiber Revolution. Textile Extensification, Alienation, and Social Stratification in Ancient Mesopotamia. *Current Anthropology* 38: 517-549.
- PALMIERI A.
- 1973 Scavi nell'area sud-occidentale di Arslantepe. Ritrovamento di una struttura templare dell'Antica Età del Bronzo. *Origini* 7: 55-228.
- 1978 Scavi ad Arslantepe (Malatya). *Quaderni de "La ricerca scientifica"* 100: 311-352.
- PALUMBI G.
- 2004 La più antica Tomba "Reale". Dati archeologici e costruzione delle ipotesi. In: FRANGIPANE M. (ed.), *Alle origini del potere. Arslantepe, la collina dei leoni*: 114-119. Roma: Electa.
- ROTHMAN M.S. (ed.)
- 2001 *Uruk Mesopotamia and Its Neighbours*. Santa Fe: School of American Research Press.
- RYDER M.
- 1965 Report on Textiles from Çatal Hüyük. *Anatolian Studies* 15: 175-176.
- 1983 *Sheep and Man*. London: Duckworth.
- 1993 The Use of Goat Hair. An Introductory Historical Review. *Anthropozoologica* 17: 37-46.
- SCHULTZ M. and SCHMIDT-SCHULTZ T.H.
- 2001 Preliminary Report on the Results of the Anthropological and Paleopathological Investigation. In: FRANGIPANE M., DI NOCERA G.M., HAUPTMANN A., MORBIDELLI P., PALMIERI A., SADORI L., SCHULTZ M. and SCHMIDT-SCHULTZ T., New Symbols of a New Power in a "Royal" Tomb from 3000 BC Arslantepe, Malatya (Turkey). *Paléorient* 27,2: 123-129.
- 2004 Studio delle ossa umane e ricostruzione della vita e della morte. In: FRANGIPANE M. (ed.), *Alle origini del potere. Arslantepe, la collina dei leoni*: 120-121. Roma: Electa.
- VAN ZEIST W.
- 1979-1980 Examen des graines de Tell es Sinn. *Anatolica* 7: 55-59.
- VOGELSANG-EASTWOOD G.
- 1987 A Re-Examination of the Fibres from the Catal Hüyük Textiles. *Oriental Carpet and Textile Studies* 3,1: 15-19.

